WINTER/SPRING 1991 ISSUE 3

The Magazine of the Commission for the Future

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21C

PREVIEWS OF A CHANGING WORLD

A World Full of Garbage – the Awful Truth about Trash

Solving Australia's 10 Greatest Problems by Barry Jones

The Mega Shops of the Next Century

Dreamlife

NEW WORLDS BEYOND SLEEP

ABC

Quantum

The read of your life

Robyn Williams

In this age of rapid change, keeping pace with new ideas is essential. **21•C**, the magazine of **THE COMMISSION FOR THE FUTURE**, previews a changing world.

To subscribe to **21•C**, simply fill in the subscription form with this magazine and post with your cheque in a stamped envelope to the **Subscription Section, Australian Government Publishing Service, GPO Box 84, Canberra, ACT, 2601.**

Barry Jones

Margaret Whitla

David Dale

Wendy Harmer

The Future starts here

WELCOME TO ISSUE 3 OF 21•C. The new-look Issue 2 received a very positive response, and sales and subscriptions have increased. We aim to continue to give you the views of interesting people, highly relevant reports and essential information.

We believe that 21•C is different in the way it explores the implications of where new developments in science, technology, and cultural and social issues are heading. We try to look at the implications of these developments and ask if this is where we really want to go.

Recently a reader, Robin Harvey, wrote to us saying: "You go beyond the Popular Mechanics approach of simply marvelling at new technological developments and address the deeper social and human issues that will be so crucial to humanity's future success."

CHRISTINE HAMILTON

In this issue we look at what we have done with our most precious resource, water. Terry Lane talks to Paul Davies [*page 62*], one of the world's foremost physicists, about his views and the prospect that scientific endeavour might eventually come to a full stop.

We take a look at an intriguing new career called 'garbology' and go on a "dig" with American archeologist Dr Bill Rathje, in a New York rubbish dump [*page 8*]. Hotdogs, almost edible after 15 years! And the possibility of running out of room for our garbage if we continue dumping at the present rate.

UNSTOPPABLE BODIES

Wendy Harmer sees the funny side of what future generations will think of us when they uncover relics of our consumer-obsessed society [*page 31*].

Dr Kenneth Dyer of Adelaide University explains how sporting champions evolve, compares training methods of the past and now and reveals what the future holds for world record breakers [*page 44*].

Acclaimed cartoonist Bruce Petty, one of the few Australians to have won an Academy Award (for animated film) offers a view of the future from his unique perspective [*page 98*].

We demolish the myths about plastics being the worst environmental offender [*page 12*], assess the futures of retailing [*page 68*] and music [*page 84*], and look at the implications of developments in artificial intelligence [*page 73*].

And of course we have our regular columns and fascinating visions.

Happy reading.

CHRISTINE HAMILTON
Editor in chief, Commission for the Future

ALL THE NEWS IN NEXT

21C

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Editor in Chief
Christine Hamilton
Aust Commission for
the Future Ltd.

Sub-editing, design and production:
Client Publishing Australia
220 Clarendon Street
East Melbourne
Phone (03) 4162644

Editorial Director
Eric Beecher
Art Director
Chong Weng-Ho
Managing Editor
Alan Morison
Production Manager
Matthew Learmonth
Designer
Dorothy Leslie
Picture research
Jane Claeys Louise Graham
Gerie Herman

Quantum Editorial Advice
Daryl Karp (Executive Producer)

Cover picture: Bobbi Fabian

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Advertising inquiries:
Government Bodies
Jenny Martin
Aust Commission for
the Future Ltd
Ph (03) 6633281

Private Sector
Ross May
Client Publishing Australia
Ph (03) 4162644

All editorial inquiries should be directed to:
The Editor, 21.C magazine,
Commission for the Future Ltd
98 Drummond Street, Carlton
Victoria Australia 3053
Ph (03) 6633281

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TRASH OR TREASURE

Researchers roaming the rubbish tips of the world are turning up surprises among the tin cans and old newspapers. Their conclusion: conventional disposal does not work, and poses a threat to the environment. At the same time, Australian research is challenging the belief that plastics are not environmentally friendly. Ten-dollar notes are being turned into compost bins, just one of many recycling projects.

PAGE 8

SCIENCE, THE DRUG

Passion and privilege is the mix, truth and discovery the aims. The name of the game: science. An addict reveals all.

PAGE 16

DREAMERS AWAKE

Strange things are happening after bedtime. Volunteers entering the dream world of scientists in the US are being encouraged to "wake up" to their subconscious adventures through a process known as lucid dreaming. Meanwhile in Australia, at least one psychotherapist maintains that in dreams, symbolism remains the key.

PAGE 36

REACH FOR THE STORES

Competition between huge regional centres will make shopping an exciting, entertaining experience next century. If you can force yourself away from the easy shopping which will be provided at home.

PAGE 68

A DRY ARGUMENT

Some ideas will hold water, others won't. When it comes to Australia's stressed river systems, the right choice becomes absolutely critical.

PAGE 80

KILLER COMPUTERS

It's a tradition. Humans eventually use advanced technology to destroy one another. So how long before the computers turn on us?

PAGE 75

FENDER BENDING

The arrival of the electric guitar meant music would never be the same. What kinds of instruments will come next?

PAGE 84

ART IN ASIA

A new scheme aims to improve Australia's image abroad through art.

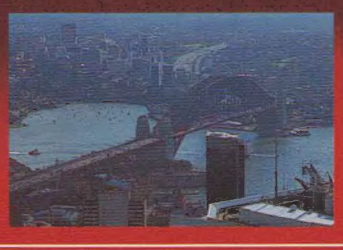
PAGE 88

ontents

STRONGER, HIGHER, FASTER

No barrier can stop them. With each generation, athletes develop the skill and technique to surpass the high standards that some thought would never be bested. But for how much longer?

PAGE 44



LIFESPAN

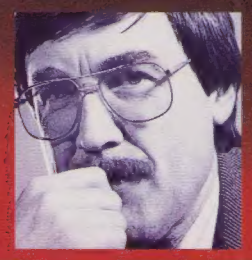
Our regular series probes perhaps its most appropriate subject: bridges.

PAGE 52

THE GREEN GAUNTLET

A network is springing up to carry the impact of environmental decision-making from the super-powers to suburban streets. And where necessary, the other way, too.

PAGE 58



THE ANSWER TO EVERYTHING

Noted physicist Paul Davies has Margaret Thatcher to thank for his life-quest exploration of the essential elements of the universe. But will she be pleased if he comes up with an answer to the biggest question of them all?

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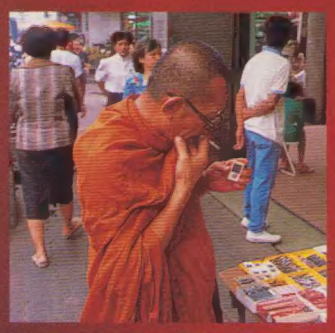

SMOKING CIRCLES

Tobacco is in retreat in the West. But new markets are being opened, especially in the unsuspecting Third World.

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NO FISH TODAY

Some fisheries are under threat because of the popularity of fish like Orange Roughie. And some inland species face possible extinction.

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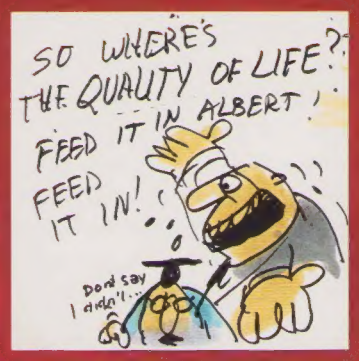

PETTY

One of Australia's most respected cartoonists offers his idiosyncratic perspective on the future.

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NEXT

16 PAGES OF NEWS, TRENDS, PRODUCTS AND RESEARCH

David Attenborough on human beings

Research indicating a link between long labour and diminished IQ in babies

Chocolate that won't melt

Credit cards that think for you

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A new Commissi

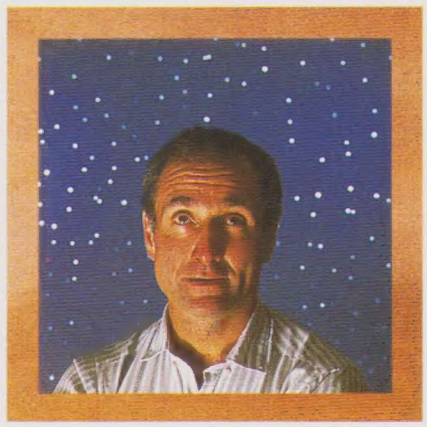
And a new future for the commission

Alfred, Lord Tennyson has a lot to answer for. But, among the doggerel, he did include a few sturdy Victorian insights: *"For I dipt into the future, far as human eye could see, Saw the Vision of the world, and all the wonder that would be".*

That, in a way, was the reason the Commission for the Future was established. Not to "dip into the future" with any intention of serious forecasting, but to get people talking about possibilities. Tennyson, on doing his dipping found it "left me with a jaundiced eye"...

"Eye, to which all order festers, all things here are out of joint:
Science moves, but slowly slowly, creeping on from point to point . . . "

Well, he was right about science, comparatively. The first few hundred thousand years of human existence saw little change. Then with scientific inventiveness came massive change and, in a word, civilisation. What we hoped the commission could do is enable Australians to discuss some of those inventions before they changed the way we live by default. Because science may be slow but its products seem to descend upon us with both speed and suddenness. And so from 1985, in the first few years of the commission, we spent much of our time reviewing the sheer range of what we might deal with. I remember several menus being suggested for our attention. Each contained daunting umbrella words like "Asia" or "Climate Change" or "Sustainability," each enough to keep several commissions going for decades.



ROBYN WILLIAMS

In a way, that's what has happened. Our progeny, Asialink, and Greenhouse Action Australia, have grown and become autonomous (though they still keep in touch) to do their particular jobs. The commission itself has now decided to focus more deliberately on a few specifics, though they will certainly change and be replaced from year to year. Accordingly, we have a new constitution and a new board. It will give us independence, flexibility and far greater immunity from the impetuous and unpredictable winds of federal politics.

The remit will be similar to the one the founding commissioners such as Phillip Adams, Leonie Sandercock, Professor Peter Mason and I were given six years ago: to show ordinary citizens that there are choices to be made, that our future is up to ourselves to determine. To make those choices we need to be informed.

But the other part of the remit, to carry out special programs and consultancies, will be somewhat different: we shall have to earn our income. Though there is an amount of money to come from government (gradually diminishing) by far the larger part of our funds must come from being consulted, providing reports, giving advice based on research. The expertise will be both in-house and sought from outside via our network of experts.

To guide our activities we have a formidable line up of influential Australians. Members of the commission include: Professor Derek Denton, one of this country's leading medical research chiefs and one who actually combines science with business: he's on the boards of David Syme (publishers of *The Age*) and the Australian Ballet. Professor Denton is one of the rare Australians to have been invited to inspect another country's (Sweden's) R&D on behalf of the OECD.

Professor Adrienne Clarke is probably the most influential woman in Australian research. She is on the board of CSIRO, on ASTEC (the Science Council) and was recently elected a Fellow of the Australian Academy of Science. She heads one of the most respected and brilliant research teams in plant genetics in the world from her lab at the University of Melbourne.

Sir Laurence Muir is one of this country's leading business identities, having been involved in banking, ACI, and Alcoa, as well as several groups with scientific focuses such as the Baker Medical Research Institute and Earthwatch.

Professor Ian Lowe has been with the commission for many years, first as friendly advisor, then as acting director, more recently as commissioner. I'm delighted that his searching analyses on conservation and sustainability will be available to us still as a member.

Dr Kevin Foley is an economist with wide experience in government and business. He is a member of the board of CSIRO and Standards Australia and was a member of the Victorian Parliament from 1976-1982. He has had a long involvement in the business of government and has been published extensively in matters of defence planning and public sector management and accountability. He recently co-authored with Professor Bill Russell a strategic review of the Victorian Parliament.

I shall continue to chair the commission. On the board proper I shall have, from the old comission, Tom Harley of BHP and Rick Farley who runs the National Farmers Federation, as well as new directors Nick Callinan (Advent Western Pacific Ltd) and the Right Rev Peter Hollingworth, Archbishop of Brisbane. I am especially delighted that Peter has agreed to join us for a number of reasons, not least that he was the guest in the very first program I edited back in 1972 when he was with the Brotherhood of St. Laurence and I had just entered the ABC.

Last but probably the most important new influence to come into the Commission for the Future is Susan Oliver, the new director. She has carved a highly successful career in public and private enterprise. Susan brings to the commission highly developed skills in Business and Strategic Planning. The first woman to graduate from Melbourne University with a Bachelor of Building, she has a diverse and interesting background. Her achievements range from managing the South Melbourne 'Emerald Hill' urban renewal project, and setting up programs of support for manufacturing industries for the Victorian Government to her own campaign of consulting for technology strategy planning. I'm sure she will meet the challenge of the "future" with the same energy and commitment as she has with all of the above.

So much for the faces, old and new. They combine a most formidable business and scientific competence with a genuine understanding of the humane vision we need to face the 21st century and beyond. It is a future that we really need to contemplate with imagination. Not perhaps with the same florid creativity expressed by Lord Tennyson, though one can sympathise with his sentiments when he wrote, still 'dipping' into the future when:

"The war-drum thobb'd no longer, and the battle-flags were furl
In the Parliament of man, the Federation of the world."

From **Locksley Hall**, Lord Tennyson 1809-92

n for the Future

That innovative future spark

I really want to dispel the myth that innovation (or in other words new, creative and possibly unique ways of finding solutions to problems) is the domain of the bright spark, the Gyro Gearloose inventor. Why? Because if we all believed we were empowered to be prime movers in creative problem-solving one could comfortably and confidently believe our human endeavours were capable of leading us to a future we could be proud of.

We are very conscious in developing themes for 21•C that while there is plenty of evidence for gloom – our lack of planetary management in the past and present is certainly gloomy – we must make room for the role models of the fantastic human endeavours which lie everywhere in our society. There is a wonderful richness of wisdom, human effort, good science, arts and culture in Australian society which will fuel years and years of fascinating issues of 21•C.

SUSAN OLIVER

The role models serve to inspire and empower, particularly offering scope for our kids to see that it is possible and highly desirable for them to participate in changing for the better the way we do many, many things today. And the solutions and the processes of finding the solutions need to be innovative. The idea is, however, that the innovator doesn't get hit over the head with a good idea but, like a good scientist or investigator, the innovator engages in the disciplined pursuit of a solution.

It can be a solution to many things but the imperative is, of course, to find how a mix of elements such as equity, justice, health, happiness, ecological diversity and sustainability and economic well being can form components of the plan for our future. When we have a plan for our future, we can begin putting together the steps required to get there, the priorities and the critical and strategic pathways.

For a number of years I developed technology strategies, the way technology can be applied to the process of manufacture, or the products of a company to give that company strategic advantage over competitors in business. The analytical tools I used illustrate that while the intention of the strategy was to find a creative, innovative means by which the company would win in the market place, the process of finding the winning strategy was hard work. It was systematic, it was data intensive, it was well informed, it was forward looking.

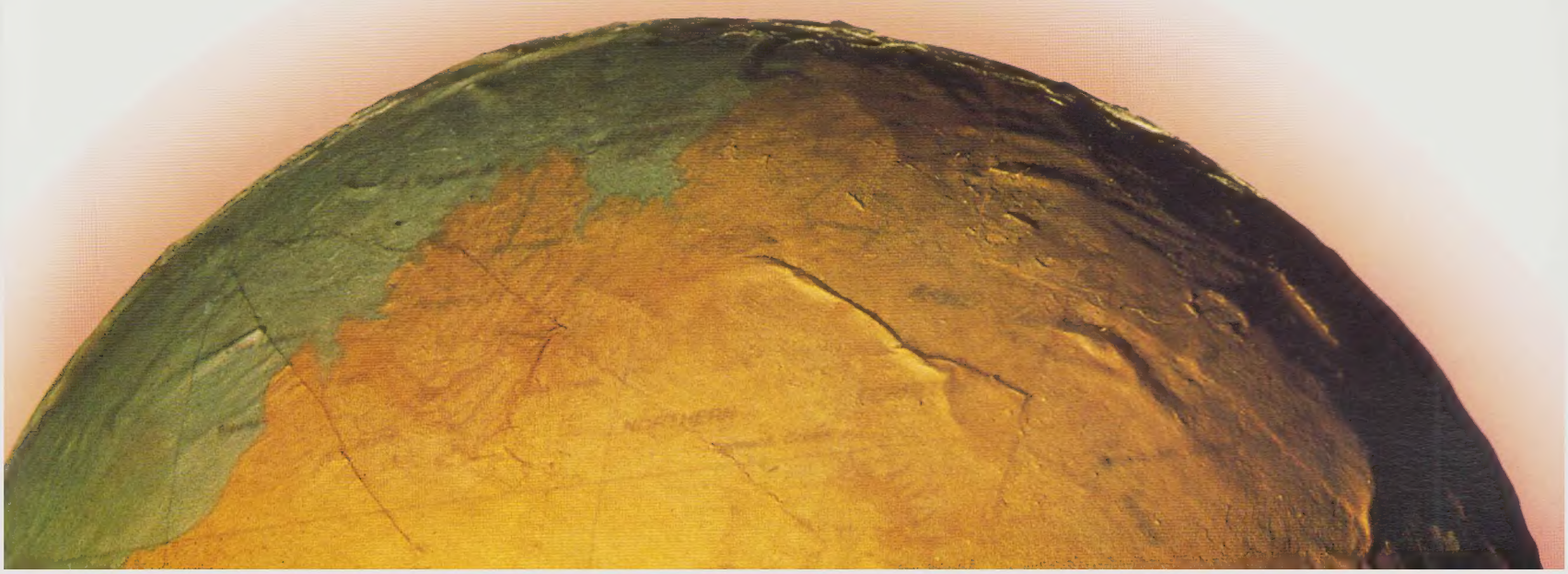
From this process emerged the new idea, the change strategy. In Australia we are often heard lamenting that we are forced to sell our technology, our inventiveness overseas. Yet it is really not surprising because the steps in taking an idea from the ideas stage to the market place are many. If we begin with the basic research (and for that we need talent, funds and world class equipment) other steps are applied research, demonstration and testing, product development and design, scale up, product manufacture, marketing, assessment of the next market, not forgetting seeking and gaining sufficient finance, addressing distribution and the aftermarket and the need to be constantly reiterating between the steps.

The commercialisation of an idea can take years and it is often very costly. This is innovation. It is not something we have been particularly good at perhaps because of the persistence required to get there in the end, and perhaps because we don't have all of the skills and players within Australia to complete the game. There is also the current rumour that we can't manage the process and integrate the steps andthere is the almost certainty that wedon'tdrect our efforts at the outset towards the market's demands and needs for goods and services.

The parallels are strong. The innovative processes to plan and achieve a desirable future need to be concerted, well informed, directed towards the needs and benefits of life on earth and very well managed.

We need to empower ourselves and our children with the will to engage in them.

And this is what we try to do at the Commission for the Future.



A DUMP CA

DAVID JOHNS

LLED EARTH

History is a half-eaten hotdog and an invasion from outer space as garbologists uncover our past – and our future – on the world's refuse dumps. And their conclusions are frightening

BY CHRISTOBEL BOTTEN

When future historians examine today's society, they will find a culture given to building vast monuments much grander in scale than the great pyramids, but hewn in garbage, not stone. These historians will be able to root through mountains of old paper, tin, glass, plastic and half-eaten hot dogs; colossal shrines of trash that are testimony to a consumer society with scant regard for replenishing the resources it exploits.

Ours will be a legacy of landfill tippings. As prominent American archaeologist Bill Rathje interprets it, we will be taken for a decadent society careering towards decline – and perhaps destruction – unless we become committed to recycling. It has happened to others. According to Dr Rathje, the Classic period of the ancient Maya civilization was one of profligate waste, followed by decline. By the time the Mayans realised their resources were running out and had instituted recycling, it was too late.

"If we compare our garbage with theirs," says Dr Rathje, "I think we can see we're still in a classic phase; that is, we're still discarding tremendous amounts of valuable resources on a daily basis. We have an important opportunity today. We can go into a period of efficiency and pragmatism, and in that way sustain our society in the style to which we've become accustomed for a much longer time."

Dr Rathje intends to get a jump on those historians who may one day judge us by our refuse. He and fellow archaeologists from the Garbage Project at the University of Arizona, Tucson, are already digging deep into America's garbage cans and landfills – and they have discovered much of the commonly-held lore about refuse is untrue. Smelly work it may be, but in examining the trashy artefacts of contemporary society – instead of ancient pots and mummies – the group is shedding light on the use and misuse of our resources.

Since the group was established in 1973 by Dr Rathje, who is the university's professor of anthropology, the insights have been "astounding". For instance, plastic is not the main culprit; paper is essentially the villain clogging up landfills. Plastic goods make up about 14 per cent of landfill refuse, whereas paper and its products make up some 40 per cent. Even paper cups – waxed and bleach-processed – are not necessarily kinder to the environment than their polystyrene counterparts.

Much of the organic garbage dumped in landfills is not biodegrading as quickly as first thought, and probably will not for a very long time. The Garbage Project has dug up, intact, whole foods from years ago. The face-mask-clad archaeologists have unearthed a steak which retained its fat after 15 years of burial; a cob of corn, with leaves and whiskers from 1971; a 1974 hot dog, waiting to be eaten and not in the least slimy. Then there are the cultural signposts, like the tie-dyed bell bottom trousers from the 1968 "summer of love," a fun find, says Garbage Project co-director Wilson Hughes.

And there are the newspapers, which help mark time for the garbage archaeologists: one 1982 tabloid from the Fresh Kills landfill outside New York city proclaimed "US Invaded by UFOs." Tim Jones, the archaeologist who cherishes this find, revealed the paper had not deteriorated at all. He is still waiting for the aliens. His colleague, research associate Dr Doug Wilson, explains: "Nothing degrades very rapidly in the landfill. We have dug up nine or 10 landfills in the US (up to 30 metres deep) and we have gone back to 1949 and been able to date the fact things were deposited there by reading the newspapers.

"When we found a 15-year-old hot dog in one landfill it was perfectly preserved, but if it had been in a fridge (all that time) it wouldn't be fit for human consumption, it would be covered in green goo." As Dr Rathje puts it: "Hot dogs – their preservatives really work!" They are one of the most common finds in American landfills. So why is it taking so long for our garbage to rot? "Landfills are not big compost piles," says Dr Rathje. Rather, the garbage in landfills is tightly contained and compacted in liners of clay, soil and plastic to prevent toxic fluids and gases leaching out into the environment. This also prevents moisture, oxygen and light from getting in – conditions

HIGH AND MIGHTY, AND JUST PLAIN HIGH

NORMAN ROBINSON

How the volume of rubbish at the biggest landfill tip in the US compares with natural and manmade monuments. Fresh Kills contains 2.4 billion feet of refuse. It was first used in 1948 and now takes half of what New Yorkers throw out weekly – 100,000 tons. When the Garbage Project dug Fresh Kills in 1989, they found normal refuse near the top; moist debris at 25-40 feet; another 15 feet down things were dripping wet. Towards the bottom of these layers, thick chunks of newspaper were blackened on the outside, as if by fire, but still readable once pried apart and emitting clouds of steam. One of the project's crew called them "newspaper bricks". A few more feet, and they found only gray slime, with lumber remnants. The Fresh Kills landfill biodgraded where other landfills didn't because the marshlands harboured the methanogenic bacteria that produce methane which helps things degrade under anaerobic conditions.

Read all about it: Corn from 1971, hot dogs from 1985 and a 1971 newspaper emerge almost unscathed. Photos: The Garbage Project.

which hamper decomposition. Neither is the garbage shredded or regularly turned, other vital factors in organic break down.

But landfills have been an historical feature since swamps were filled in and made into suburbs. It was only in the 1960s and 1970s that people realised there might be a problem in indiscriminately filling in swampy areas with hazardous waste. The US has about 5500 active landfills, but few new ones are being approved. Most are filling up: the world's biggest, Fresh Kills outside New York, covers 1215 hectares and contains 2.4 billion cubic feet of refuse, 25 times the volume of the Great Pyramid at Giza.

In Australia, a recent Federal Government discussion paper on waste minimisation and recycling has called for the amount of waste dumped into landfill sites each year to be halved by the year 2000. One news report interpreted the proposal to mean Australians should cut the amount of garbage they produce – or be buried in it.

The burial threat, says Wilson Hughes, is ridiculous, although he applauds the setting of a goal. "It is an example of a ridiculous statement; it's political hysteria. How much would have to be produced to be buried in it? It may be less ridiculous in the case of New York city. But in Sydney the trash could be transported 200 kilometres inland, somewhere isolated. It would cost more but people will have to learn they have to pay the cost of processing waste."

Mr Hughes, who gave up working with juvenile delinquents to join the Garbage Project 17 years ago, visited Australia with Dr Rathje in the late 1970s to set up a pilot project looking into ways to dispose of fresh garbage in metropolitan Sydney. The archaeologists were asked to make projections about waste disposal in Sydney's suburbs based on the American experience. Was that like asking the Americans to make the mistakes first and then borrow from their successes instead? "Sure. One of the reasons to study history is to learn from it and not repeat mistakes," says Mr Hughes.

The project, however, did not progress beyond the pilot stage – no funds – but according to the Garbage Project archaeologists, the link with Australia has been maintained. "We have more communication with Australians and New Zealanders than with archaeologists in Mexico or Canada, who have taken on the European theoretical structure where archaeology is seen as history," says Tim Jones. "The Australians and New Zealanders have taken on the US system. We have strong links, lots of communication."

But this practice of so-called applied archaeology does not necessarily make them keen forecasters. Pressed for a prediction at an Oregon recycling conference, Mr Hughes said he thought the garbage of the 1990s would be plastic, just as Dustin Hoffman had been told to get into "plastics" in *The Graduate*. In fact, the volume of plastics in landfills has not increased.

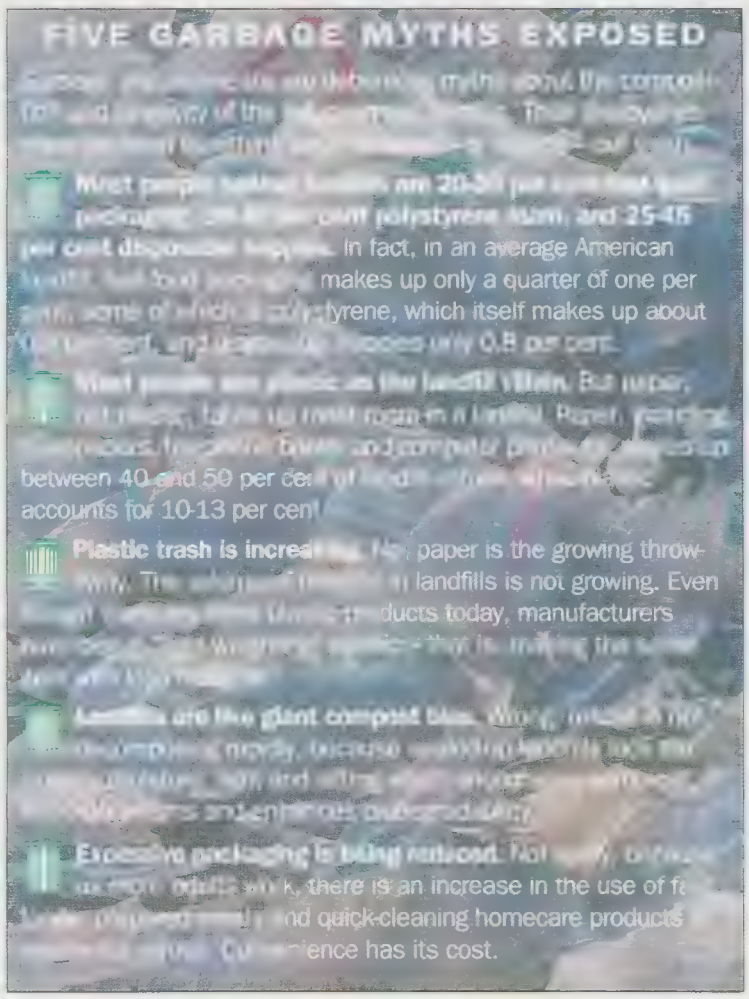
"If the trend had continued, it would probably have held true," says Mr Hughes, explaining that "what happened is the manufacturers began down-sizing – or light-weighting – plastics, and it has not increased as we expected." By improving manufacturing to make thinner, stronger plastic, two-litre plastic soda bottles which weighed 80 grams when introduced in 1980 now weigh about 60 grams. This is the environmental (and profit) imperative at work, and it could avert a Maya-like end to civilisation as we know it.

Mr Hughes is willing to cast a line into the future. He believes our society can escape disaster if, with better education, it takes advice and acts upon reducing waste, employs efficient recycling and reuses otherwise exploited resources. It is a political crisis rather than a garbage crisis, he says, calling for leadership in controlling consumption.

But he warns against hysteria – he cites as an example the Styro Cops in Portland, Oregon, who police styrofoam use, a banned substance in that State. Moreover, he warns that it takes time for a society to change its evil ways. We must allow time for governments to set goals, for public education, for "marketplace realities" to effect change. In the past decade, for instance, the plastic industry has become "more responsive to the public's desire for environmentally-friendly products."

"Eventually you will see fewer plastic polymers used in packaging," he predicts, with more standardisation of packaging materials "instead of 16 different blends as each manufacturer tries to develop something unique." "Maybe we'll use something recyclable, although there are only so many park benches you can make from recycled plastic."

As for the bigger picture: "In prehistoric societies a civilisation would fall but another would move in and take over. In the global situation today we don't have the luxury of making a mistake and surviving, therefore we are saying now our environment warrants better use. There are so many things that don't need to be wasted, that don't need to be manufactured, distributed, thrown away only to end up in a landfill." As Dr Rathje says: "To compare our castoffs with those of our ancestors is sobering: In no other civilisation has garbage ever been more grand – or grandiose – or had more to say about its creators."



THE ENVIRONMENTAL LEDGER

It used to seem obvious. If you were a green consumer, you campaigned for the return of re-usable milk bottles; you nagged your local greengrocer to replace plastic with paper bags. You worried about the mounds of plastic containers, wrappers, computers, pens, bags – you name it – that would be sitting around for ages in the world's dumps.

You condemned a society that threw its plastic castoffs into the wind to clog rivers and drape around trees like deformed Christmas decorations.

In the US, you convinced McDonalds to replace plastic hamburger wraps with paper. In Australia, you might have joined the Stamp Out Plastics group and picketed supermarkets. Plastics became the symbol of environmental irresponsibility, of a rapacious throw-away society. According to international research, it was never that simple. The green consumer of the past may have been misguided.

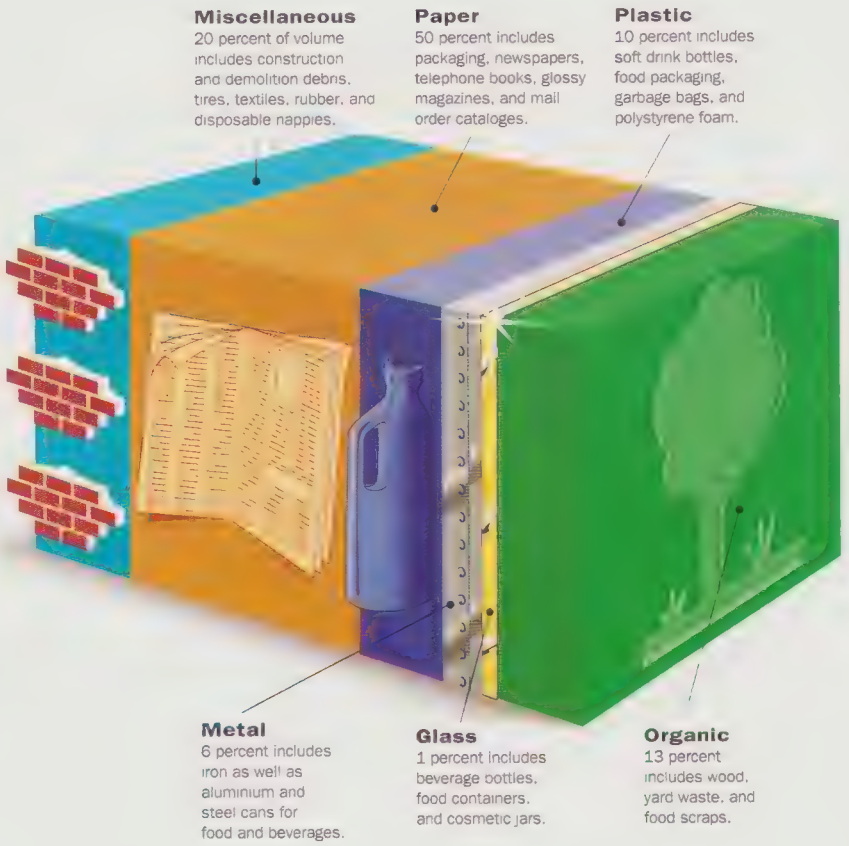
A method of research, already influencing legislation in Europe and the US, assesses the environmental impact of materials and products from their cradle to their grave. Called life cycle analysis, it doesn't stop with biodegradability or rubbish dumps. This complex equation brings in the energy used in manufacture and transport, the discharge of air and water pollutants and the potential for re-use and recyclability of products. It even takes into account the the energy stored within a product.

These new equations, to govern future sustainable development and the responsibility of industry through the life of products, put plastic in a different perspective. Some believe that polymers will be so valuable in future that we will be mining the world's dumps.

BY RHONDA DREDGE

Manufacturing: The plastics industry is a minor energy user in Australia. The industry consumes about 70 petajoules of energy to produce one million tonnes of plastic a year. This represents only 2.7 per cent of total energy usage in Australia. The big spenders: transport with 36 per cent and dwellings with 19.7 per cent. By comparison, the steel industry consumes 3.8 per cent for a smaller production. Unlike steel, which is smelted at high temperatures, plastics are formed at moderate temperatures, providing an immediate contribution to the environment through reduced greenhouse emissions. Plastic production is estimated to account for less than one per cent of the total Greenhouse emissions in Australia.

HOW THE WASTE EQUATION WORKS OUT



A recent analysis by Professor Martin Hocking in *Science* compares the production of two competitive materials – paper and polystyrene. Producing a tonne of paper consumes 9000-12,000 kilograms of steam and 980 kilowatt-hours of energy, compared with 5000 kilograms and 150 kilowatt hours for a tonne of polystyrene. Similarly, a tonne of paper results in 190 cubic metres of effluent, 60 kilograms of suspended solids, seven kilograms of organochlorine residues and 10 kilograms of sulphur dioxide. Polystyrene is the winner for greenhouse emissions, a tonne resulting in two cubic metres of effluent, a trace of suspended solids, no organochlorides and the same amount of sulphur dioxide.

The one area where polystyrene loses is in the 50 kilograms of pentane it takes to blow a tonne of foam. This is used to replace chlorofluorocarbons (CFCs) which deplete the ozone layer. In 1986, plastics accounted for 24 per cent of total CFC consumption. CFCs were banned in 1989 for some plastics and will be phased out totally by 1994. The industry has already reduced use by about 40 per cent since 1988.

Transport: If only the energy consumed in the production of materials is considered, the savings through use of plastics is not large. But this is only part of the picture. Energy is consumed in transporting the raw material to first-use point, then to storage, the retailer, consumer and disposal of the used product. As plastics are lightweight compared to all substitute materials such as glass, steel or paper, they offer significant transport fuel savings. It is estimated, for example, that the substitution of 70 kilograms of plastics for steel components in a one tonne car would reduce fuel consumption by 4.5 per cent. Assuming four million vehicles in Australia travel about 20,000 kilometres a year, this is a saving of 432 million litres of fuel and a reduction of almost one million tonnes of greenhouse gases a year.

Waste: One reason plastics have such a bad name is that discarded packaging is highly visible. An Environment Protection Authority report found that plastics made up 66 per cent of 2231 litter items collected in Melbourne's waterways over a year. The bulk of plastic waste, however, goes into landfill sites. In Australia. This amounts to 450,000 tonnes, 70 per cent of this household waste. International studies have shown that plastics make up at the most 10 per cent by weight of landfill sites and about 18 per cent by volume. The stability of plastic means it does not contribute significantly to ground water contamination or to methane from composting.

Potential for recycling: One pervasive myth is that plastics are difficult to recycle. In the past, this has been perpetuated by manufacturers who claimed it was not economically viable. In fact, the Australian industry recycles 50 per cent of post-consumer industrial waste, but the present rate for household waste is extremely low – less than one per cent a year. The low economic value of plastics is

their weakness – they do not appear to be worth picking up, sorting, cleaning and transporting. From an environmental perspective, this area offers most potential for controlling the damaging effects of people's consumption habits.

Plastics can be used, reused, transformed and downgraded, perhaps serving as several different products over 40 to 50 years. In the process, they offer significant environmental savings. The estimated energy requirements for manufacturing plastics from recycled materials is only three per cent of that required for virgin material and the greenhouse emissions are only eight per cent. Countries around the world are setting household waste recycling goals of 25-50 per cent, but as yet none have achieved these figures. In Australia, the Federal Government has set a 25 per cent goal by 1995 and several industry initiatives are under way:

•Smorgon Consolidated Industries has imported European technology to turn mixed post-consumer plastics into an extruded timber substitute called Syntal;

•ACI has established a $5 million plant in Wodonga, Victoria, to recycle PET (polyethylene tetephthalate) from soft drink bottles for use as PVC film in its own operations. ACI has set a target of 30 per cent.

•Full Cycle Plastics opened a $3 million plant in Melbourne last year with the capacity to recycle 30 per cent of the country's annual production of HDPE (high density polyethelene) milk and cream bottles.

•ICI Australia has set up a pilot plant to recycle PVC fruit juice bottles into consumer packaging for products such as sunscreen and shampoo.

In Australia, laws forbid plastics recycling for food containers. But technical developments now make it possible for certain types of plastic components to be used repeatedly, in their original shape and for their original purpose. In Holland, for example, Pepsi Cola are using PET bottles which can be refilled 25 times. GE Plastics offer a new polycarbonate grade called Lexan which, as bottles, can be reused 50 to 100 times.

For viable recycling, US experience has recommended the following steps:

- multi-material kerbside collection;
- mandatory separation requirements;
- use of household set-out containers;
- weekly collection frequency;
- widest possible range of materials included in the program;
- effective promotion, with clear specification of the types of plastic products to be included. The Plastics Industry Association has introduced a voluntary labelling system.

DAVID JOHNS

At Craigeburn, Victoria, Note Printing Australia shreds flawed $10 notes to confetti. The confetti is trucked to RELN PLASTICS in NSW where it is turned into compost bins.

Incineration: Plastics are made from fossil fuels and represent "captured energy" because they do not lose their energy content in manufacture. In fact, they have more heating value than wood or brown coal, and almost as much as natural gas and oil. Their unrestricted use as a fuel is controversial, however, because there is widespread belief that they produce toxic fumes and residues. A study by the US National Bureau of Standards showed that fumes from most plastics are only as toxic as those from wood fires and not as harmful as burning paper or wool. Their value for power generation is being exploited at a much greater rate overseas than in Australia. It is predicted that by 1995, 300 mass-burn incinerators will be operating in the US. Emission gas control systems are highly efficient and the resultant contribution to greenhouse gas load is believed to be small.

EXAMPLES OF LIFE CYCLE ANALYSIS

Only when all stages of a product's life are analysed can the consumer begin to gain some appreciation of its relative impact on the environment. While a daunting task at present, Europe is about to introduce a co-ordinated eco-labelling system to assist consumers. The many studies conducted on packaging, which now represents 30.7 per cent of the total plastics used in Australia, show that the environment need not be a loser through inappropriate consumer action.

Plastic vs paper cups: One of the most publicised cases is the analysis by Professor Hocking which compares the life cycle of a disposable polystyrene cup with a paper one. To make a paper cup it takes about 33 grams of wood and bark and 1.5 grams of other chemicals. The wax to make it waterproof consumes 4.1 of petroleum. By contrast, the polystyrene cup consumes 3.2 grams of petroleum and uses 0.05 grams of other chemicals. The paper cup weighs 10.1 grams, the polystyrene 1.5 grams, meaning more fossil fuel is consumed in transporting the paper cup. The paper cup produces almost twice the amount of greenhouse gases and 90 times the amount of effluent, which when it breaks down in a settling pond consumes more than 500 times the amount of oxygen.

The wax on the paper makes recycling very difficult and uneconomic, but the plastic can be recycled and used in other applications. Both paper and plastic can be cleanly incinerated, but the plastic yields twice as much. The paper cup breaks down, either by robbing water of oxygen and turning it into carbon dioxide, or by producing methane in landfill. The plastic cup is inert and does not break down.

The milk bottle conundrum: An analysis by Dr David Evans of Melbourne University compares the energy used in producing, transporting and disposing of glass, paper and plastic milk bottles. The energy for a 2 litre HDPE bottle is 3.0 megajoules per litre compared to 4.6 for a PE coated carton and 18.2 for a 0.6 litre glass bottle. If the glass bottle is reused 20 times the energy is reduced to 2.6 megajoules per litre of packaging. However, when the recycling part of the equation is included, the glass requires the same processing at high temperatures and the same energy each time it is recycled. By contrast, the HDPE can be recycled at 3 per cent of the energy of virgin plastic.

Plastic vs paper bags: A comparison by the West German Government of polyethylene and paper supermarket bags shows that plastic is the big winner on both energy of manufacture and greenhouse emissions. The plastic consumes about 70 per cent of the energy used in the manufacture of paper bags while producing 60 per cent of the air-polluting emissions of unbleached paper and 44 per cent of that of paper combinations. Savings are also made when the effective weight of transport is reduced. One thousand plastic supermarket bags weigh 18 kg yet 1000 paper bags of the same capacity weigh 36 kg. There is a twofold penalty every time they are transported, empty or filled.

THE MANUFACTURER

Six years ago Richard Bean, development manager of Brickwood Holdings, had an attitude that was typical of many plastic manufacturers. "Frankly, at the time we talked about recycling but thought it was ruddy stupid. We argued that we were doing our bit for the environment. By using plastic we were significantly reducing the energy and waste generated by other forms of packaging," he says.

"I remember discussing the issue with someone from the Friends of the Earth. She conceded the point but said just because we were doing less damage to the environment was no excuse for not recycling. I could think of no appropriate answer."

That's when the company, involved in manufacturing all of Australia's plastic milk bottles, decided to take responsibility for recovering waste material it generated. In 1988, the company began an 18-month process of developing a production line to shred, wash, separate and extrude a resin almost identical in quality to the original HDPE plastic. The $3 million plant, with an annual recycling capacity of 5000 tonnes – more than a quarter of Australia's annual consumption of 16,000 tonnes – opened last year next to the Brickwood Cheltenham plant.

Another load for recycling: more uses are being found all the time.

Named Full Cycle Plastics, the operation was joined by a consortium of companies comprising Chemplex, Mobil and Exxon, who saw great potential in what is said to be one of the world's largest and most modern plants for recyling household waste HDPE. In the first six months Full Cycle recycled more post-consumer HDPE than Europe has in the past year. All of it came from Perth, Queensland and country Victoria, and all was at the rate of $250 a tonne, with freight paid by the company. Because of the difficulties in obtaining material, the plant is running at 18 per cent capacity. Some 3500 tonnes a year is the break even point, says Mr Bean. The problems faced by Full Cycle point to the economic equation for recycling being shaky without legislative guarantee of supply.

THE SCIENTIST

A Melbourne manufacturer of plastic pipe fittings recently approached the RMIT Polymer Technology Centre for advice on improving the thermal properties of his products. When Ed Kosior, director of the centre, inspected the company's production facilities, he found two tonnes of waste from the machining process lying on the floor.

To his surprise, he was told that it would be carted to the tip. "The company was too busy with its production to address the waste situation and was dumping $2000 worth of usable material a week," he says. Ensuring that the waste went to a good market became an integral part of a consultancy that has become bread and butter for the centre. "We walk in to solve a technical problem and end up looking at the whole operation in terms of people, material and energy management."

The massive changes taking place within the plastics industry have forced Mr Kosior, an industrial chemist, into varied roles. He now finds himself involved in product design, economics, industry infrastructure, efficiency, management, training and waste management, as well as the design of new polymer formulations.

"The first energy crisis in 1973 set the stage for what is happening now," he says."Someone in the US said at the time that: 'The Shah of Iran is the plastic industry's best friend'. The price of oil doubled and it put the value of plastics in perspective." Companies began looking at recycling, at conserving the resource and gaining the maximum benefits from hydrocarbons. The technology that we are seeing implemented today, he says, was developed in 1970s in response to the crisis.

The RMIT centre was established in October 1990 and has already completed 250 consultancy projects. An area of major promise and national importance combines the centre's research skills in a consortium with groups from Monash University, CSIRO, Material Research Laboratories and industrial partners Chemplex and Moldflow to develop high value-added products.

The group is now testing Australia's first compatabilisers, developed by CSIRO in Melbourne. These are octopus-like molecules which react chemically with a range of polymers to create plastic alloys with highly predictable properties. Their big advantage is that low-cost commodity plastics such as polystyrenes and polyethylenes can be transformed into high-grade engineering materials. Australia imports all of its engineering plastics, 100,000 tonnes a year at a cost of $4000-$10,000 a tonne.

But import replacement is not the only benefit. "The next step will be to develop compatabilisers that can be applied to recycling mixed plastics. It's now a lot cheaper to polymerise from hydrocarbons than to collect, sort and reprocess waste. We want to change the balance of the equation."

Another project with Smorgon involves the recycling of PET, which makes up 20 per cent of household waste. This is being collected and converted into small volumes of sheet material, says Mr Kosior. "Our approach will be to look at additives so the recycled resin can be recovered to allow processing by injection moulding. PET is currently only used for consumer products but its molecular weight could be modified for use as automotive and electronic components."

Many of these initiatives slot into the cascade concept of how Mr Kosior envisions plastic being used in the future. First, it could be used in a high-value application like food packaging, then recycled into a secondary use, such as a car bumper-bar or under dashboard component. At the end of the vehicle's life, it could become a building material or polymer-reinforced concrete or insulation. The cascade would terminate with the burning of the plastic in a suitable incinerator, recovering virtually all of the energy that went into its manufacture decades earlier.

THE DESIGNER

When Dr Chris Ryan examines his absolutely disposable pen, with its metal band inset into three types of plastic, he already sees it as a relic of the past. The quick-snack plastic containers that have a useful lifetime of all of five minutes, from the servery counter until their contents are consumed, will also be relics.

"It's amazing that an extremely valuable and sophisticated material like plastic is used in the least valuable way. None of the cost of recycling or disposal is built into the economics of these products," he says. As director of the Key Centre for Design at RMIT and Australia's representative on the European Eco-design Committee, Dr Ryan is preparing Australia for a new age in manufacturing.

In consultation with the Plastics Industry Association, the centre has compiled a resource guide Design for Plastics Recycling and is running a competition for tertiary students based on its specifications.

Ways of designing for recyclability include minimising the number of plastics in one product, or at least providing clearly identified break points for ease of separation into similar material; avoiding dissimilar adhesives and paper labels; using colourants sparingly; and including international plastic code markings.

Rhonda Dredge is a freelance writer.

Why fairness must come first

For Australia to be a crusading force in protecting international human rights in the next century, it must first tend its own backyard, says Brian Burdekin, Federal Human Rights Commissioner.

To predict where Australia's future lies in the field of international human rights, one must first look at the genesis of modern human rights law. It was born from the conviction in the years following the Second World War that the way to avoid future wars and conflict was to avoid the circumstances that had previously fermented them – the oppression of vulnerable minorities, discrimination against ethnic minorities and so on.

BRIAN BURDEKIN

Australia has an international interest in seeing human rights observed. But we must accept that others, in my view perfectly legitimately, will draw attention to shortcomings in Australia.

It is not a negative thing for other countries to point the finger at us for what we are doing or not doing in relation to Aborigines, or the mentally ill, or homeless children, or women, or ethnic minorities. It's precisely what the international human rights debate should be about. Part of my vision for the future would be a world in which commentary by Australia on human rights violations in other countries, from China to Chile, is not seen as an intrusion in the "domestic affairs" of another country but as a legitimate subject for national and international concern.

At present, it's one of the things that many governments refuse to accept. It's taboo for diplomats to interfere in the domestic scene of another country. Governments say: "We govern, we're a sovereign state, don't interfere in our affairs. . . " "Tiananmen Square isn't Australia's business. . . " I don't accept those arguments.

And what can we do about violations? In the next century, I envisage a new internationalism which would strengthen and diversify the mechanisms which give the world community the ability to bring to account countries which offend. But we have to deal with our own backyard. Here – with the mentally ill, homeless children, intellectually disadvantaged, physically disabled – violations of the basic rights of millions of Australians still occur every day.

Speaking as a lawyer, in 50 years' time I would like to see a legal system that is accessible to *all* Australians.

At the moment, you have to be well-to-do or wealthy, or so poor you can get Legal Aid, in order to gain access to our court system to redress violations of rights. That is an appalling situation. There is assumption that common law is a very good legal system. It isn't. It has basically protected property, contracts, commerce and business during its 700 years of development. What it did for the mentally ill, the intellectually disadvantaged, women, children and the disabled you can write on the back of a stamp. The whole area of human rights protection is embryonic in terms of the machinery existing in Australia.

The totally unacceptable paradox of our present judicial system is that most of the people who really need protection are the ones who can least afford it. By next century, we should have a system of law and a protection of rights accessible to those who most need it. That system will be very different to our present legal and judicial system. It will incorporate a great deal more conciliation, as opposed to adversorial proceedings: what lawyers term "alternative dispute resolution mechanisms". This legal system should also genuinely and effectively protect the rights of children. Today the reality is that in many thousands of cases where children need real help, we do nothing.

And far sooner than in 50 years, there should be an appropriate and sustainable definition – and implementation – of self-determination for Australia's indigenous people. One of the great blots on our nation is the state and status of many of our Aboriginal people. It's no good us continually rabbiting on about indigenous minorities having the right to self-determination. We've got to work out sensibly what that means. Our legal system of the future should be more sensitive to the strengths of Aboriginal culture and their particular needs. And it is something we must work out as a nation. It's not something anyone can impose on anybody else.

In the next 10 years I would hope the government's council of reconciliation will produce something realistic and sustainable. Treaties are like the law. They have to have life breathed into them, otherwise they are meaningless.

The reason it is said that patriotism is the last refuge of the scoundrel is that people will justify the otherwise indefensible by an appeal to national loyalty. To what? We are all human beings. Why should the fact that I'm an Australian give me the right to kill or injure people from another country? From a human rights standpoint, it's not a tenable proposition.

I'd like to see a world where we cease to hear arguments about "states' rights". In my view, states don't have rights. Individuals have rights. States have obligations to respect and protect those rights. In that sense, I'm very much an internationalist.

I wouldn't simply want to see the international community resolve itself into a series of blocs – the EEC here, an Australian and New Zealand bloc there. However, I think that is almost certain to be a transitional point on the way to a more international society.

A corollary of a more international community is that the international mechanisms to bring to heel countries guilty of human rights offences should grow significantly in strength. Whether that will mean more economic sanctions, or arms embargoes, or permanent international monitoring machinery is an open question. I believe all of these will play a role.

We are gradually growing towards that new internationalism. And the standards we are administering in Australia, in terms of equal opportunities, equal protection of the law, non-discrimination, the right to a decent standard of living, are international, multilateral standards. That we and many other countries are increasingly accepting and acting on those international standards today can only bode well for international human rights in the 21st century.

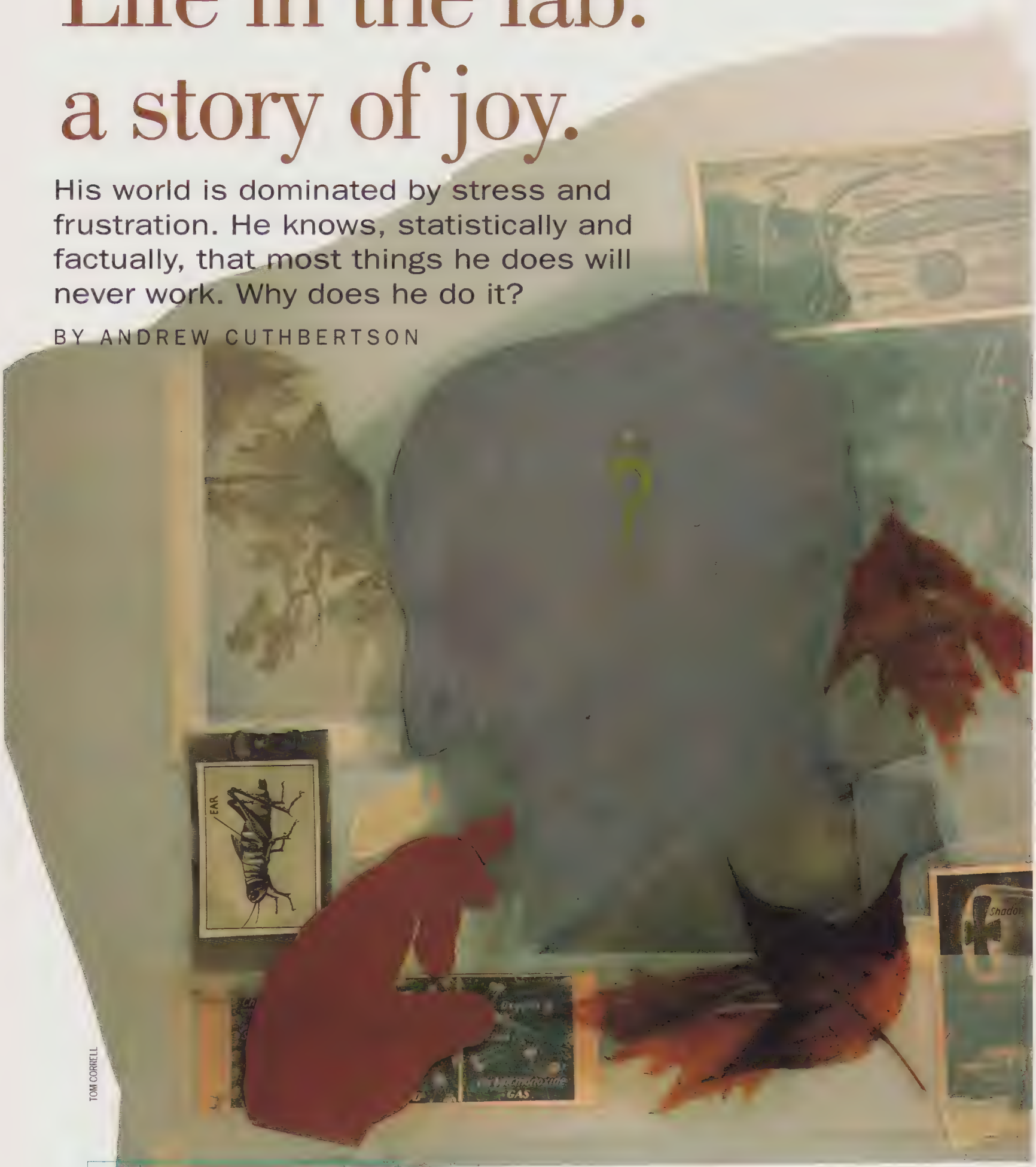
Brian Burdekin, was a lawyer in Melbourne before becoming a diplomat. He was Gough Whitlam's private secretary, then posted to Washington with the diplomatic service. Five years ago he assumed effective control of the Federal Government's human rights body, the Human Rights and Equal Opportunities Commission.

HOOKED!

Life in the lab: a story of joy.

His world is dominated by stress and frustration. He knows, statistically and factually, that most things he does will never work. Why does he do it?

BY ANDREW CUTHBERTSON



TOM CORRELL

A WALK through our laboratory is like a stroll through heaven and hell. On a bad day, you would say it is perilously cramped, full of too many rumbling machines, radioactivity, dangerous chemicals, big and bursting egos. But on a good day, it seems a wondrously functional place where everything is waiting its turn to help you to ask and answer fascinating questions of nature.

Science is fluid and flowing and evolving continuously around us, which is why the people in it may be excused for feeling occasionally dizzy or even sick. Scientific research is an intensely human activity, and bears little resemblance to the textbook science we learn at school. This is not to imply that these changes in scientific doctrine are arbitrary. They come in an avalanche of new knowledge, encased in a strong sense of democracy and even revolution. Eventually, even the most closely held and favourite theories of the most powerful established scientists will fall before the weight of new findings.

The aim in science is for clarity of understanding of natural phenomena. These phenomena, whether the division of a cell or the formation of a new star, wear many veils hiding many layers of complexity. Each time a veil is lifted we get a clearer picture of the nature that lies beneath, but it is still a hazy view and we may be looking at a tiny bump on the backside of the whole. Scientists must then call of their knowledge, their intuition, their imagination, to make sense of these fragmented glimpses of nature.

They must try to form a temporary picture to provide a moderately solid foundation for the next set of experiments, which should (if they are good experiments) bring us either a clearer or a broader view. Thus one should not sneer at a textbook description that appears set in stone. We should simply be aware that the description is an informed fantasy, created at this particular time in the history of science.

To me, it is this organic evolution of science and the paradox of its objectivist philosophy, juxtaposed with its intensely human side, which makes the pursuit of scientific research so wonderfully fascinating – and so many light-years ahead of what it seemed at school.

One inescapable fact in biological research is that most of the things you do will not work. So how do you cope with this uncomfortable and, at times, heartbreaking situation? The answer is that each time, you somehow have to believe that everything about your experiment will work, while at the same time remaining resilient enough to withstand the statistical certainty that mostly you will fail.

But when things do work, the results are like drugs. I get the same thrill from an unexpected and exciting finding in the laboratory as someone smoking crack or injecting heroin (or so I imagine). And what I do is legal, and encouraged. Yet it is a lot easier to get heroin than results, so the withdrawal between the rushes can seem long and barren.

Then, after weeks of frustration, when even the most simple things that you have done a million times just fail for the sake of failing, someone up there drops something in your lap, and you feel sensational. This all-powerful and benevolent being is like a Greek god having sport, tossing a morsel of encouragement just in time to see how long the poor sod will toil.

I have often wondered whether medical research attracts unusual characters, or whether they become that way after some years in the laboratory. There is certainly more room for eccentricity in research, compared with more conventional medical work. In some places it is encouraged.

During my first week at a prominent Australian institution, I got into a lift and a gangly man with bright red hair got in with me. I think it was at about the fifth floor he commented that I would look great in motor cycle leathers. He said nothing else. He then got out. It turned out that this was one of the PhD students. He was charming and very intelligent; a gay medical graduate with a background of psychiatric problems compounded by the ill effects of hallucinogenic drugs. Some people might think he had been dealt a rough hand. Yet the people running the place felt that he should be encouraged and cultivated, which they did for quite a few years, not instantly discarded.

Part of this ethos of tolerance was imprinted by some marvellous characters who have graced medical research in Australia. One of the most delightful was Professor R.D. (Pansy) Wright. He was an experimental physiologist almost to the day that he died, a champion of academic and human freedoms, a creator of medical research institutions, dismissive of cant and woolly thinking and possessor of a fine sense of bawdy Australian humour.

When asked, he would always offer younger people advice. Sometimes, he would make a suggestion off the cuff and one could take it or leave it. Even in his 80s, Professor Wright would perform experiments which required him to be trussed up in a sterile operating suit with gloves on all day. Naturally enough, it was periodically necessary for him to pee, which he was wont to do in a handy sink. To avoid the drudgery of "unscrubbing" from his operating garb, he would sometimes instruct his trusty staff to extract his organ using metal forceps, direct it briefly at the porcelain, and return it to the sterile cocoon. The experiment could then continue. It was during such a procedure that he stated sagely and with a completely straight face, "Always the cold tap, never the hot tap".

The neglect of tolerance in science can have pitfalls. A reasonably conservative professional group in Australia set up a research institute. After a world-wide search, a director was found. The professionals were cautious, conservative people (men, mainly) and they decided to appoint him for a limited period, allowing them to terminate the relationship if the fellow was not performing to their liking.

There were a couple of problems with the new chap. Not with his science, by any means, but he did have a beard, and he did insist of wearing shorts in summer, and the only suit he possessed was an unusual colour and was brought out at rather disturbing occasions, like the annual general meeting. The man seemed a little eccentric, at least to the board. So after a year or two the board decided not to renew the director's contract and to search the world again for someone more conservative.

In time, the old director departed and the new one became ensconced. Then the board was struck a one-two blow. Within a short time, the old director was elected a Fellow of the Royal Society of London, a rare and esteemed honour which falls to a mere handful of Australian scientists; and their new director, after a period of contemplation, came to work in a frock and announced that he was having a sex change.

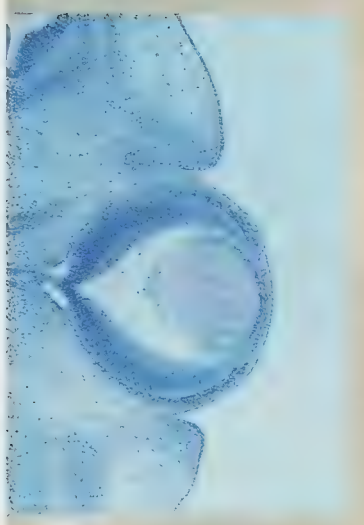
Stress in science is different from that in medical practice. In some ways it is more insidious, because it comes very much from within. When a patient dies or an operation doesn't go well, good doctors will agonise over whether things could have been done differently. Would different drugs, different tests, perhaps a different operation have produced a better outcome? Were there subtle hints that could have been followed up?

This searching can be stressful, and the stresses in scientific research are more nebulous, but no less severe. For me, one powerful reason for trying to make a career in research is the potent desire to prove something, to find something that no-one else has managed to find, to work things out in some way. People who do it are often more

AN EYE FOR AN EYE

For my whole research career I have been fascinated by the visual system: by our eyes and the wonders that make them work, and by the eye diseases that cause blindness. As well, I have been lucky enough to be working at a time when a momentous revolution is taking place in medicine, the revolution of molecular biology. Molecular biologists try to understand life at the most fundamental level. They are interested in how our genetic information is coded in the DNA of our cells, and how this huge library of information is selectively called upon to dictate our development and daily functioning from fertilised egg to adult human being.

Molecular biologists study how diseases and death may be caused by perturbations in this most exquisite sub-microscopic machinery. Each person has about 50 to 100,000 genes listed linearly in our DNA and while this information is present in the nucleus of every cell in our body, only a subset of these genes is "turned on", or "expressed" at any particular time; that is, transcribed into RNA and then translated into proteins. The subset of genes turned on in any cell defines both the form and the function of that cell, and so "gene regulation" is one of the most fundamental mysteries of life.



Seen under the microscope, a section of the developing eye – at this stage only a millimetre or two across – reveals its beauty and complexity.

The regulation of genes during the development of a human being – both in individual cells distributed throughout the body, and with each of these cells with time – forms an incredible symphony of life, the co-ordination of which we are only just beginning to understand. I am interested in genes that are uniquely expressed in the eye. Each gene has both a coding region, which dictates the ultimate amino acid sequence in the resulting protein coded for by the gene, and a "promoter" or address region, which tells the gene, in part, where and when to be turned on.

Thus a promoter for a particular gene might cause expression of the structural part of that gene in the foetal liver, or the adult brain, depending on the DNA sequence of the particular promoter and many other features of gene regulation which are now being elucidated. We have been able to find genes that are turned on in parts of the eye but nowhere else in the body, and one of the most exciting things about this is that the promoters controlling these genes have the ability to direct gene expression to parts of the eye and nowhere else.

Although scientists have puzzled over the mysteries of the visual system for centuries, it is only now we are beginning to understand the molecular mechanisms that govern sight, and in turn, determine the cause of blindness.

Ultimately, we would like to be able to link these promoters to therapeutic genes to create forms of therapy for eye disease which will be extremely potent and exquisitely specific. That is, they will work in the eye, where they are supposed to, but will have no side effects elsewhere.

While this dream of a new and better way to treat eye disease is a long way off in years and effort, it can be personally comforting and important to have some kind of tough but attainable goal leading the research on.

BY ANDREW CUTHBERTSON

than a little driven, more than a little obsessed and the drive and obsession comes from some inner engine that demands a kind of success. The trouble is that success is to some extent determined by luck.

America is a tough place. While research workers can get paid well there, it is common for a significant part of an American university researcher's salary to come from their grants . . . and these are extremely competitive grants which at present have only a one-in-four chance of success.

In Australia, in spite of the great influence that America has had on scientific research, there is in some ways a greater sense of perspective, but also an untoward caution about getting too excited about anything. Americans really do believe that they live in the centre of the scientific world, and most would never question that this is an unmitigated good thing. But there are reasons, quite separate from questions of leisure, crime, family, friends and nationalism, for doing scientific research in a well-equipped place that is peripheral to the politics and turmoil associated with being at the centre of the universe. Rumours and fads have a much larger place in science than people might imagine.

In the US, a hot result in one laboratory will spread by word of mouth across the country before anything appears in print, and well before the results have been verified by the group performing the work. Next, many laboratories working in similar areas of research may change what they are doing to test the new idea themselves, to tweak it or disprove it. This is a healthy self-stabilising force in science, but it is necessarily disruptive. One must assume that these other people were all working hard on what they considered to be the most promising line of work until the latest excited gossip and that the original line of work will suffer to some extent.

THE AGE

Professor R.D. (Pansy) Wright.

Of course we are, in Australia, part of this huge network of science and we also get the news, the gossip and some of the wrong ideas that can excite and confuse us. But there is a sense in Australia that we are far enough removed to be able to carry a line of investigation to its logical conclusion without unnecessary chopping and changing.

Many similarities can be found when one compares science in Australia and the US, but it is a lot more interesting to concentrate of the differences. Americans are enthusiasts. They applaud effort and ambition in what sometimes seems a naive and callous way. America is great when you are top of the heap and there is a very strong incentive to stay there because the slippery slope doesn't stop until you hit concrete at the bottom.

There are too many good ideas in biology, too many possible experiments to do: some safe and plodding, others more daring but with a high chance of failure and humiliation at the end.

There are kinds of experiments and even whole facets of science, that are appealing because they, or their fruits, are understandable to the public. They appear to have some obvious future utility, and in a way, the whole of medical research falls into this comforting niche. There is nothing wrong with either utility or public appreciation, but pursuing research because of these features may be a trap, short-changing both the investigators and the public, who are paying for it. This is because basic science – to elucidate fundamental principals of nature, rather than a product for immediate retail sale – is the engine which produces the truly original ideas in science (and, ultimately, most of the biggest money-makers for industry as well).

In scientific research we ask a question of Nature and then try to answer it, using all of the technological and cognitive tools available to us at our time in history. To borrow a phrase, we stand on the shoulders of giants who have tried to answer questions before us in this process which is essentially cumulative, exquisitely exciting and, with all its flaws, uniquely human.

After medical training at the University of Melbourne and the Royal Melbourne Hospital, Andrew Cuthbertson did a PhD at the Walter & Eliza Hall Institute and a Post-doctoral Fellowship at the Howard Florey Institute before moving to his current position National Institutes of Health, in Bethesda, Maryland. He has just published a book: Duchenne de Boulogne and the Mechanism of Human Facial Expression (CUP).

"The future isn't what it used to be."
Arthur C. Clarke

NEXT

21•C's SECTION OF NEWS AND TRENDS

IQ concern on birth delay

Controversy has arisen over a US report which cites a link between long labour and lower IQ in babies. CHRISTOBEL BOTTEN reports from New York

The idea that prolonged labour may intellectually impair babies has until now been the stuff of physicians' suspicions and anecdotal evidence. But a controversial new report published in a US medical journal suggests that babies delivered after their mothers have laboured for more than 12 hours may suffer dents to their IQ as well as their soft heads.

In *Obstetrics and Gynaecology*, biostatistician Dr Douglas Y. Rowland and obstetrician Dr Frederick J. Roemer, both from Cleveland, Ohio, have presented statistical analyses which imply extended natural births may contribute to a degree of fetal brain damage and reduced IQ level in later life. The results come from Dr Rowland's careful analysis of long-term obstetric data collected in the 1950s by Dr Roemer, who became concerned about the potential damage to babies born by caesarean (surgical removal) after long labour compared with their younger siblings born by elective caesarean. Such is the import of the data – its conclusions about IQ and its appraisal of the birthing process – it is sure to enliven the battle already raging between the defenders and the critics of rising caesarean rates.

Not that fuelling that controversy was the authors' intention, said Dr Rowland. On the contrary, Dr Rowland said Dr Roemer was concerned that the study would be seen as advocating caesarean over natural delivery. All Dr Roemer wanted was to offer support and information to physicians who must decide when they should surgically intervene in overly long and potentially harmful labour.

Dr Roemer suggests 12 hours is long enough. As Dr Roemer described it in his paper, a baby during labour is not unlike a nail being pounded through a board. Just as the nail deforms when it encounters a hard knot, so too may a baby's soft, vulnerable head sustain injury if the birth passage is obstructed and

KAT PLASTARAS

labour contractions unproductively slam it for hours against the rigid pelvic bone.

Dr Roemer, now retired, followed his suspicions and during the 1950s began examining the births of members of the generation now regarded as the Baby Boomers, in all about 2000 cases from about 700 families. He and his wife, a graduate nurse, pored over hand-copied hospital records and chose a group of 30 babies delivered by caesarean section after more than 12 hours of labour. These children were compared with a group of 40 younger siblings, each of whom had avoided the trauma of labour when their mother's physician elected to schedule caesarean deliveries. This meant Dr Roemer was able to survey children subject to the same genetic and environmental (household and school) influences, which otherwise could affect their intellect.

For years, Dr Roemer followed the progress of each child in each family in his study, even asking after their grooming habits and whether or not they were pleasant. When each child was old enough to have his or her IQ assessed, between age eight and 10, he obtained standardised "school success scores" peculiar to the Cleveland education system. He also harvested a wealth of information from teacher and parental questionnaires, which, until he took the data to Dr Rowland in 1988, remained unexamined.

Now, after careful analysis, the authors have come up with evidence contrary to the popular view that first-born children are inevitably the brightest, thanks to the

CONTINUED PAGE 20

AUSTRALIAN NEWS

Storms ahead

The Greenhouse effect is expected to increase summer rains over two-thirds of Australia. But it will not improve the flushing capacity of river systems, according to important new findings from the CSIRO's division of atmospheric research in Melbourne. "We can expect fewer days of rainfall, but when it does rain it will have more of the intensity of a tropical storm," said Dr Barrie Pittock, leader of CSIRO's climate impact group. "We can also expect an increase in the number of dry spells." This projection is based on the doubling of carbon dioxide levels, expected by 2030.

Green light for girls

Girls are catching up with boys in science, according to the results of the 1991 Australian Schools Science Competition. Carried out by the education testing centre of the University of NSW, the competition drew 238,000 entries internationally. This year, the number of girl entrants rose to 54 per cent. One trailblazer, Narelle Bramich, winner of last year's State Electricity Commission of Victoria science and technology young achiever's award, is now going for her PhD in Zoology.

Welcome aboard

The population of the world could reach 8.5 billion by 2025 before levelling out at 10.2 billion by about 2090, according to a report by the UN Population Fund. In the past 25 years, the birth rate in developing countries has fallen from 6.1 to 3.9 per couple. Africa simply moved from 6.6 to 6.2, but there has been a significant drop in the fertility rate in China. The report warns that population control is urgent because of "the extent of urban growth, environmental damage, impending food crisis in many developing countries, extent of infant and maternal mortality, and mounting pressure of migration."

School by fax

The electronic classroom has arrived at three isoslated schools in the Riverina district of NSW. The test program means a teacher can conduct lessons using a fax to send an assignment, and computers and phones to answer queries. The system, aimed at improving school retention rates in rural areas, could eventually link students across the nation in one classroom.

It adds up to success

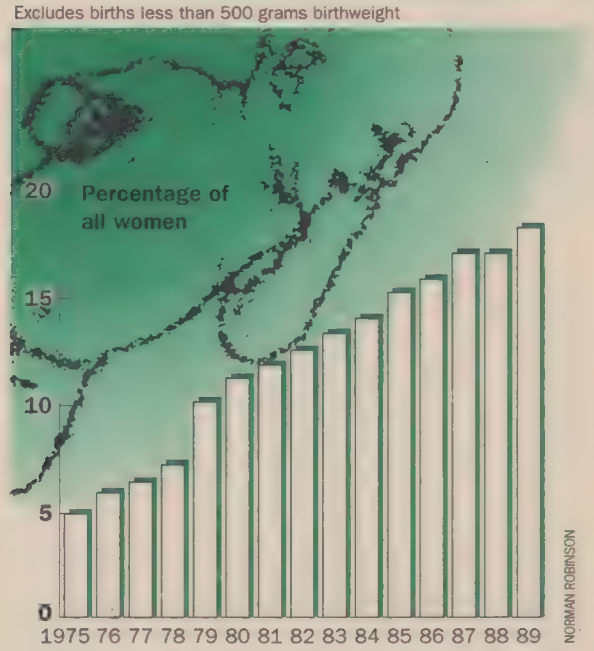
The former Minister for Education, Mr Dawkins, has won support from State Governments to make maths and science compulsory for Year 11 and 12 students. He hopes the increased numbers, particularly among girls, will "ensure Australia is making the best of its human resources." Schools were isolated from the real world, he said.

FROM PAGE 19

CAESAREAN SECTION IN WOMEN

Confined in Western Australia. (1975 – 89)

Excludes births less than 500 grams birthweight



No Australia-wide statistics on Caesarian births have been compiled. But research in WA indicates that the number of Caesarian births is rising in line with US trends. More research is needed to determine the reasons.

attention lavished upon them because of their temporary "only child" status. Rather the authors have discovered that the younger siblings in the study intellectually out-perform older brothers and sisters who suffered the trauma of prolonged labour."The probands (first-born babies) had significantly lower IQ scores than their siblings born by elective caesarean with no labour," says the study, reporting that 20 of the 30 birth-trauma children had lower IQ scores than one or more of their younger siblings. And this was not a coincidence: "Probands had the lowest IQ scores in their families, significantly more often than could be expected to occur randomly," it reports.

According to the study, scores for the 40 younger children averaged about 118 (Dr Rowland puts an average score for white middle class children at 110), while the 30 children who had a traumatic birth registered a significantly lower average score of 107. The study also found the birth-trauma children (29 of the 30 were probands) lagged behind the younger siblings on every measure including "performance evaluations" graded by their schools. Dr Roemer has said these findings fit with his theory that prolonged and obstructed labour may harm intellectual development later in life. But Dr Roemer had to wait until he retired before his theory, his suspicions, were statistically verified.

Only then did he find the time to team up with the younger Dr Rowland, who works in the department of epidemiology and biostatistics in the school of medicine at Case Western Reserve University, Cleveland. Dr Rowland took on the challenge because he was impressed with Dr Roemer's energy, charm and intelligence. Moreover, he displayed "wonderful research intuition and meticulous data collection", qualities described by Dr Rowland as rare among clinicians. The raw data Dr Roemer presented to Dr Rowland allowed him to pursue the statistical analysis of IQ, a rare opportunity given well-known intra-family comparisons published last century were found to be based on faked data.

Now the authors have ideas and accurate data enough to put together three more statistical analyses, from breech births to birth-order of twins. Indeed, Dr Rowland suggested Dr Roemer should one day make his work available as a data base for other researchers. According to Dr Rowland, Dr Roemer believes that "birth is one of the most traumatic and potentially dangerous events that a person can encounter in his or her whole life." But he does not recommend mothers elect to have caesarean instead of natural birth just to help a baby's brain power.

"Women thinking of offspring and potential IQ should not want to undergo this operation to save three or four points (on the IQ score). That is not reasonable," said Dr Rowland. "It is only something that should be weighed in the decision to undertake longer labour. Remember, since caesarean delivery involves an operation, it puts a mother at three times the risk for mortality. And there are always exceptions. From the anecdotal end of it, several senior and bright colleagues have told me they were born after long labour, one after 28 hours." Of the response so far to the findings, Dr Rowland reiterated: "One of Dr Roemer's greatest fears is that our findings would be taken as a piece of ammo and thrown into battle. There truly is a war going on; there is a lot of hype as to whether there should be more or fewer caesareans."

Wary of that debate, the authors are more than willing to respond to specific criticisms of the study and the methodology employed. For instance, obstetrician Dr Ronald A. Chez from the University of South Florida College of Medicine in Tampa, Florida, said in an editorial accompanying the study that the findings did not convince him to alter the way he now managed women in labour.

Dr Chez wrote that although the study was "remarkable" for its long-term follow-up and its principal finding was "highly provocative", he still had doubts about its relevance to current practice. Obstetricians now had access to better medications including anaesthetics and analgesics, as well as more sophisticated monitoring of foetal and maternal vital signs to help make informed medical decisions about birthing methods. "However, these data may help explain the intellectual capacities of those of us whose mothers insist they laboured for two or more days," he writes. The authors counter that non-alarmist, medical decision making should take their findings into account, particularly given the continuing belief that natural childbirth is best. "In some cases, if there is any expectation of a long labour, says Dr Rowland, "it would be best for the later IQ of the child to at least strongly consider intervening."

And the authors have just one more plea: they are collecting data on women whose first baby was delivered by caesarean section, and whose subsequent babies were born naturally. Women interested in answering questions from the authors may write to Dr Rowland, care of 21.C.

JAPAN, INC.

Let your credit card do the thinking

The Japanese are using "smart" cards for a wide variety of transactions and many users prefer the cards to cash, according to a new report.

Smart cards look like ordinary credit cards, but contain a microchip. In some, the chip includes a microprocessor and a memory; others contain only memory. More sophisticated models also have miniature display, keypad, and battery, say Steve Worthington and Ronald Brown, authors of the report. Known as supersmart cards, they can be used without a computer terminal.

The Japanese plan to expand the cards to overseas markets, a move that may threaten American credit-card companies, according to Worthington and Brown. Japan's largest credit-card issuer, JCB, will compete with Visa, MasterCard, and American Express for personal customers for the first time in the US, Canada, Britain and France.

SOURCE: THE FUTURIST

Plastic Cards in Japan by Steve Worthington and Ronald Brown. Available from Post-News, Stoke-sub-Hamdon, Somerset TA14 6BR, England. 1990.

Hitachi has developed an all-in-one desktop videophone which incorporates transmission of voice, data and video signals and can be used internationally. Passports and ID cards are also becoming more visual. Dai Nippon Printing can now produce reduced-size holograms on a photosensitive material, a breakthrough allowing holograms to be scaled down from same-size to one-tenth of the object.

SOURCE:NEW TECHNOLOGY JAPAN

Design teams at Matsushita Electric Corporation are using "fuzzy logic" to counter consumer resistance to appliances that have a mind-numbing array of functions. By adding electronic sensors linked to "fuzzy" decision-making software, it should be possible to use them without having to read complex instructions. This technology is vital for the latest palm-sized video cameras, so small that camera shake is a serious handicap.

SOURCE: FOCUSJAPAN

Japanese women are buying pantyhose soaked in insect repellent to ward off pests outdoors. Kanebo, a leading textile maker, also offers stockings for the health-conscious impregnated with vitamin C. Others offer varied fragrances. A rival, Wacoal, recently offered pearl-studded stockings but at $7000 a pair they proved too expensive for all except a handful of well-heeled brides.

SOURCE: BUSINESS WEEK

TYPE OF DELIVERY AND HOURS OF ESTABLISHED LABOUR DURING BIRTH

Confined in Western Australia. 1989

Type of Delivery	No Labour		less than 1		1-4		5-12		13-18		19-24		More than 24		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Normal	–	–	–	–	7586	85.6	7832	67.4	557	43.5	85	34.8	25	38.5	16085	64.1
Vacuum	–	–	–	–	366	4.1	1322	11.4	218	17.0	42	17.2	15	23.1	1963	7.8
Forceps	–	–	–	–	431	4.9	1505	13.0	267	20.8	55	22.5	9	13.8	2267	9.0
Breech Manoeuvre	–	–	–	–	98	1.1	129	1.1	10	0.8	–	–	2	3.1	239	1.0
Elective Caesarean	2356	78.0	–	–	–	–	–	–	–	–	–	–	–	–	2356	9.4
Emergency Caesarean	388	22.0	275	100.0	382	4.3	832	7.2	229	17.9	62	25.4	14	21.5	2182	8.7
Total	2744	100.0	275	100.0	8863	100.0	11620	100.0	1281	100.0	244	100.0	65	100.0	25092	100.0

Love, life, death and bliss

For some, it was once populate or perish. For others, it's now copulate and cherish. David Attenborough talks to TERRY LANE

For some creatures, the consequence of copulation is death. Does that mean the moment of ecstasy just before death is so sublime that they're prepared to risk anything? Spiders, for instance, have to approach copulation with the utmost caution. Why do they do it? What drives them?

If you look at human beings, again and again individuals do crazy things which wreck their social lives, wreck their financial lives, their whole pattern of life. Every morning you see it in the newspapers. Why? One says, "Well it's the moment of ecstasy." That's a kind of dodging explanation. Your tiny spider risks death by approaching this huge female which will probably eat him if he is not very careful. All kinds of animals endure incredible hardships, and the consequences all lead to that point where the genes are handed on to the next generation, which, of course, is the basis of the theory popularly known as the Selfish Gene. This is to say we are not the individuals we think we are, but simply vehicles which transfer the gene from one generation to the next. You could say that man is simply a device invented by genes to get itself to the moon.

David Attenborough

But there has to be some payoff. Whether we think it is adequate or not, the payoff is the pleasure that makes the act of procreation irresistible.

Maybe so. Even after that, people go to extraordinary lengths to discover where their children are. Until I became a grandfather, I thought "Grandparents are dotty, they're besotted with these silly little kids and they're all a pain." But the fact is I view my grandchildren as quite different from other babies.

They're perfect.

They're perfect and beautiful, but you have a stake in them, as it were. It's extraordinary. This obsession with the continuation of hereditary line is very interesting. Yet certain animals don't have it. The dwarf mongoose lives in colonies of 20 or 30 in Africa, and they usually occupy a disused termite shell. In that colony there is just one female which produces and one male which is her mate and the rest, the children of this group, are involved in the business of the colony's safety. Some are sentinels, watching out for hawks, others act as nursemaids while the parents go out and feed. Amazingly enough, young virgin females will lactate, will produce milk to feed their younger brothers and sisters.

So this is a mammalian equivalent of the beehive.

Yes, that's right. And this is a great problem for evolutionary biology. But the degree of relatedness between you and your brother and sister is exactly the same as, or is about the same as the degree between you and your own offspring in which you have introduced another outside parent. So the Selfish Gene theory explains why it is genetically worthwhile for a sentinel or nursemaid to look after its sisters rather than mate itself. People in our own society who don't breed are none the less contributing for the next generation because they contribute culturally.

This edited extract is from Terry Lane Talks With David Attenborough, an ABC Spoken Word cassette available from ABC Shops and leading bookshops, rrp $16.95.

No extinction fears for limos and utes

An observer could be forgiven for concluding that many Australians are born with one wheel in their hands and four on the roadway. And those cars multiply like rabbits, as ANDREW MASTERSON reports

You would think, perhaps, that the past few years of trembling headlines about the hole in the ozone layer, Greenhouse gases, global warming, smog alerts, dwindling oil supplies and, for that matter, the perils of sharing the road with behatted men in Swedish sedans might have caused many people to reconsider their relationship to automobiles.

As Australian consumers increasingly hunt out goods and services that promise to be nice to dolphins, major industries, including the car manufacturers, proudly tout their improved environmentally friendly products, as much in an effort to match supply to expectation as to save us from a slow bio-catastrophe. While we might now ardently demand unleaded petrol and exhaust emission controls, it seems that we haven't taken such eco-conscious reasoning to its logical conclusion and begun using fewer cars.

Quite the reverse. Ever since the first Model-T Ford rumbled and sputtered its way along a rutted bridle path somewhere in this country we have been locked in a passionate fixation with the internal combustion engine that shows no sign of abating, minor year-to-year fluctuations notwithstanding. We are already well ahead of even comparatively recent projections for car ownership and still, according to some sources, not yet at saturation point.

There is a problem, however, in defining terms such as "saturation" in this context. In 1982, for instance, the OECD estimated that the saturation level for cars in Australia – that is, the point at which very few people between the ages of 17 and 70 do not own one – to be 550 per 1000 population. The organisation predicted that we would reach that target at some stage in the next century. We reached it – indeed, passed it – in 1985. In the 1988-89 financial year the Federal Chamber of Automotive Industries (FCAI) calculated the rate at 564 cars per 1000 people on an Australia-wide basis. On a state-by-state basis, Tasmania won the prize for abundant car ownership with a rate of 617.1 per 1000. The Northern Territory let the side down a bit, recording only 465.7.

Theoretically, though, the saturation level is much higher. In a 1988 report, the Automotive Industry Council (AIC) suggested that it could be as high as 630 cars per 1000, on the basis that 60-63 per cent of the population is physically and legally capable of driving.

'Not only are we buying new cars, we are also hanging on to the ones we've already got.'

According to the Automotive News Service, in 1926 there were 18.92 people in Australia for every car on the road. Just over 100,500 were sold that year. By 1966, the ratio had dropped to the point where people outnumbered cars by only three to one. The dealers sold another 378,748. In 1989, the latest figures available, there was one car for every 1.77 people, with 599,831 more sold. During that whole period the nation's population almost trebled. Yearly car sales went up, somewhat unevenly, at roughly twice that rate.

An acquisitive bunch we may be, but we are also increasingly careful with our money. The FCAI has estimated that of the seven million-odd cars and station wagons on the register on September 30, 1988, about 4.1 million of them were built between 1971 and 1982. More than half a million were older still. In other words, not only are we buying new cars, we are also hanging on to the ones we've already got.

If you chuck in all the utilities, panel vans, rigid trucks, articulated trucks, non-freight-carrying trucks and buses, but exclude the motorcycles (because that's what the Australian Bureau of Statistics does), there were about 9,489,500 vehicles registered as at June 30, 1989. Bikes would have numbered just over 303,000, so call it a nice round 9.8 million.

That means that there are just over 12 vehicles for each one of Australia's 800,000 km of roads. It also means that if they all went out at once for a pleasant Sunday drive, there would be a lot of very nervous kangaroos standing along the verges.

The car population, obviously, is not static. Just as new cars are purchased each year, others are scrapped due to old age, accidents, write-offs and so on. The AIC estimates that about 70 per cent of new car purchases are made to replace unwanted or discarded vehicles. In a "fully developed" automotive market, such as Japan, the replacement rate is 80 per cent.

In 1989, according to the FCAI, 249,300 passenger vehicles were scrapped. Total scrapped vehicles numbered 300,800. Significantly, the passenger vehicle figure does not represent a huge increase on the 202,300 that were scrapped in 1970-71. The true difference shows up when the numbers are converted into a percentage of the whole passenger vehicle fleet for the respective years. In 1970-71, the scrappage rate was 5.43 per cent; in 1989, it was 3.44 per cent. The lowest scrappage rate recorded in recent years was in 1987-88, when it dropped to 3.02 per cent, or 213,400 cars. Between 1970-71 and 1988-89 about 4,852,700 passenger vehicles were scrapped (scrappage rate for all vehicles would be about 30 per cent higher).

The average weight of passenger cars is decreasing, says the AIC. In 1988, it was 1210 kg; in 1995 it is expected to be 1065 kg, reflecting an increase in plastic and aluminium as components of body weight at the expense of iron and steel. If we therefore take an extremely conservative estimate of 1100 kg for each car scrapped between 1970-71 and 1988-89 (and thus heretically and erroneously imply that Honda

CONTINUED PAGE 22

N E X T

FROM PAGE 21

Civics were more popular than Holden Kingswoods), we find out that the whole lot weighed, minimum, 5,107,870 tonnes. More than half of it was iron and steel, with the rest made up of plastics, aluminium, glass and other bits and bobs. That, in anybody's language, is an enormous load of old car parts. Some authorities, however, expected it to be even larger. In its 1988 report, the AIC noted: "A significant and unexpected fall in scrapping rates has occurred in Australia over the last decade; from the 1970s average of 5.3 per cent per annum to around 4 per cent by 1987.

"This fall was not forecast by the OECD, which expected scrapping rates to rise to 5.7 per cent by 1985 and then continue on a trend-line basis to rise to 6.6 per cent by 1995 and beyond."

The Massachussets Institute of Technology was even more extravagant in its calculations. Its model for the Australian car market forecast a scrappage rate of 7.0 per cent in 1979, rising to 7.5 per cent in 1990.

Australia, in fact, has one of the lowest scrappage rates among industrialised nations. Using OECD paradigms, the AIC calculated that scrappage rates in the early eighties for Japan, for example, were 9.0 per cent per annum. Britain averaged 7.9 per cent; the US, 7.2 per cent. Only Italy recorded a rate lower than Australia's 4.5 per cent, coming in at 4.0 per cent.

In environmental terms, of course, a low scrappage rate is beneficial, representing a lower net loss of non-recyclable materials and a lower net energy expenditure on utilising recyclable components. Its existence, however, is not historically due to active environmental considerations. Its base is economic, reflecting the relationship between new car prices and disposable income. The AIC stated: "It seems likely that the increase in new and used vehicle prices led to an increase in the life expectancy of Australian vehicles – ie an extension of the technical life of cars at the scrapping margin.

"The upward movement in vehicle prices in Australia may also explain why Australia's scrapping rates have fallen while scrapping rates in most other OECD countries have risen over the same period."

It should be noted that a low scrappage rate is not seen by the automotive industry as necessarily a desirable thing. Fewer cars consigned to the wreckers, after all, mean fewer cars bought. Smallish by comparison to elsewhere the rate may be, but it still led to almost a quarter of a million cars going to the grave in 1988-89. That's still a lot of iron, steel, aluminium and plastic up for grabs.

The technology for recovering and recycling the metal parts of cars has long been available and, according to the FCAI, reasonably well used. Until recently, however, virtually all plastic components – an increasing proportion of the weight of the total fleet – were simply destroyed. That situation is changing, slowly, but development in this area must first resolve a classic conflict between environmental and economic considerations.

"Just about all the metals are recycled," said Mr Tony Pennington, executive officer of the FCAI. "I'd estimate about 70 per cent of the iron, steel and aluminium. A lot of newer cars have labels on their plastic components, giving details of how they can be recycled."

Mr Pennington said that non-stressed metal components were suitable for recycling within the automotive industries. It is possible, therefore, that parts of your car were once part of somebody else's.

Similarly, some of the plastics developed in comparatively recent times are theoretically capable of being re-used within the industry. Mr Pennington quoted the examples of plastics said to have a "memory" – that is, capable of absorbing energy and then returning to a predetermined shape, such as bumper bars – in this regard.

Other types of plastic may be re-used in non-stressed constructions, such as glove boxes, dash boards and seat-belt covers.

"In some types of new cars, for instance the new S-series Mercedes, everything is labelled with recycling information," he said. "That sort of thing is now coming through the industry. However, that sort of technology might cost about $20,000 per car. With an expensive car like a Mercedes, you can afford to use expensive materials, but what if the whole car itself is priced at $20,000?

"Recycling is a priority for car manufacturers, but it is a competing priority. We're trying to reduce exhaust emissions. We've already reduced them 90 per cent in the past 15 years. We're also trying to increase occupant protection. That means building stronger cars, which are often heavier cars, and which therefore burn more fuel.

"In addition, we're also trying to get the price of cars down. For the last two years we've been running at less than the CPI.

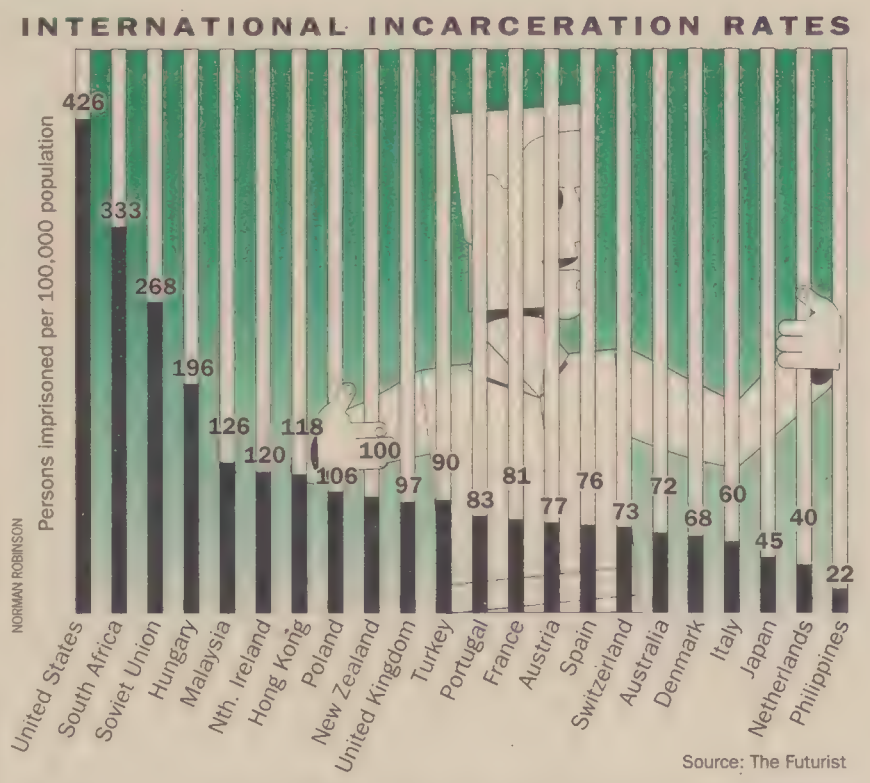
"In other words, we're trying to produce cars that are environmentally friendly, safe, and cheap. There's a huge conflict there, for starters. Nevertheless, the automotive industry has a pretty good record, to date, for cleaning up its act. We're keen to make advances in recycling. Non-recyclable materials represent a net waste and earn us a bad reputation that we don't want." Mr Pennington predicted that new cars would be fully recyclable by the turn of the century.

Recyclability, however, is not a retrospective condition. Even if the FCAI's optimism proves to be well founded, there is still the problem of the current national fleet. If we assume that the number of people rich and pretentious enough to afford brand new S-series Mercs is statistically insignificant, it is probably a fair bet that virtually all of the 7.1 million passenger cars contain little, if any, recyclable plastic. It is also safe to assume that the same condition applies to many of the cars coming on-line.

If we take our conservative body weight estimate of 1100kg, and assume that plastic components account for about 15 per cent of that, we end up at the sobering conclusion that there are roughly 1.2 million tonnes of non-recyclable plastic trundling along the highways and by-ways of Australia.

Given that cars have an approximate lifespan of 15 years, it is not a problem that will disappear for quite some considerable time. Of course, future problems could be ameliorated substantially if we, as a nation, attempted to adopt a more reasonable ratio of cars to people, aiming, say, for a return to the mid-sixties level of three to one. That would bring about not only a decrease in the net energy expended in vehicle manufacture, but also, probably, a decrease in total exhaust emissions, fuel consumption and, quite possibly, men in hats driving Swedish sedans.

SOCIETY



Source: The Futurist

U.S. Leads World In Jail Population

The US now has the world's highest known incarceration rate, with 426 prisoners per 100,000 population, according to a recent report, America Behind Bars. A decade ago, the US ranked third, behind South Africa and the Soviet Union, but since then has experienced a doubling of prison and jail populations, says the report's author, Marc Mauer, assistant director of the Sentencing Project, a non-profit organisation that promotes the development of alternative sentencing programs.

One reason for the US surge past South Africa and the Soviet Union is the different directions that the three nations have taken in criminal justice policies, says Mauer. In the Soviet Union under Mikhail Gorbachev, many political prisoners have been released and minor offenders granted amnesty. Thus, the prison population has declined dramatically. South Africa's prison population has remained relatively stable in the past 10 years, rising only by about 11 per cent.

Much of the high rate of incarceration in the US is explained by its higher crime rate compared with many other countries, such as those in Western Europe. But criminal justice policies also influence the number of people behind bars, says Mauer. In the 1980s, crackdowns on crime resulted in mandatory minimum sentences and restrictive parole policies. Mauer believes that a national dialogue on issues of crime and punishment is needed in the United States, for in spite of a record number of criminals in prison, "we are still left with high rates of crime and an epidemic of drug abuse."

THE FUTURIST

WORKS IN PROGRESS

A round-up of current Australian research, compiled by PETER POCKLEY

This photograph of a tardigrade, magnified 880 times illustrates how the animal gained its nick-name of water bear. The Zoology Department at UNE-Armidale is carrying out studies of the animal which may help in understanding some of the fundamentals of life.

Rip Van Bear

This beastie, enlarged 880 times in an electron microscope, is one of the world's biggest sleepers. Barely visible to the naked eye on the moss which provides its nutrients, the minute tardigrade goes by the name of water bear because of its toy-like appearance.

But, the water bear is more than just cute; it is a scientific phenomenon for it is known to be able to sleep for up to 112 years when the environmental going gets tough.

Associate Professor Hal Heatwole and zoologist colleagues of the University of New England in Armidale, NSW, are studying the tardigrade's ability to go into suspended animation. He said: "They retract inside their outside shells and drop their metabolic rate to almost nothing. When we can see an animal which can switch life on and off, we must be getting down to the essentials of life."

The researchers want to find out how the animal's cells reorganise their structure to survive during the dormant state.

Tardigrades might even score a journey into space. Professor Heatwole says research overseas has shown the dormant animal can survive in a vacuum at temperatures near absolute zero (minus 273 degrees C). He is trying to get the animal included in experiments on a future Space Shuttle flight.

The mouth of the tardigrade magnified 3200 times. The animal lives on moss and is known for its ability to enter a state of deep dormancy. Its longest recorded dormant period is 112 years.

White asbestos confirmed as cause of mesothelioma

Blue asbestos has now been joined by white asbestos as a cause of mesothelioma. The Australian National Institute of Occupational Health and Safety in Sydney has assessed the risk of contracting mesothelioma from all types of asbestos and concludes that, although white asbestos presents a lower risk than the blue variety, it nonetheless is a significant hazardous substance.

The six-year study, led by Dr James Leigh, is understood to be the most extensive of its kind in the world. There has been a high level of interest in asbestos-related diseases in Australia following the delayed outbreak of mesothelioma cases among workers exposed to high levels of blue asbestos in an Australian mine and plants manufacturing asbestos products for building and insulation.

Dr Leigh's work established that risk of mesothelioma is related to the degree of exposure to asbestos. Legal action by affected workers from the now-closed Wittenoom mine in Western Australia continues to attract headlines as the operating company attempts to minimise damages and settlements. When the Governor of NSW, Rear Admiral Sir David Martin, had to retire from office last year due to mesothelioma contracted during his naval service and almost immediately died, public concern reached new levels.

While mesothelioma remains a rare disease, Australia has the highest incidence in the world. Annual notifications have almost tripled in the past decade to 314 in 1990. The number of known deaths since 1980 is 1455, mostly males.

Dr Ted Emmett, chief executive of Worksafe Australia which runs the Institute, says worse is to come with another 6000 cases predicted over the next two decades. The latency period of 25 to 50 years between initial exposure and onset of mesothelioma means that incidence in Australia will rise continually to about 2010 and then fall as a result of tight controls on exposure to asbestos taking effect two decades ago. Nearly all sufferers die within a year of diagnosis.

About two-thirds of the cases are associated with blue asbestos-based manufacturing and user industries, including the traditional big users – shipbuilding, power stations and railways. The latest research shows, though, that risks from white asbestos, which is mined mainly in Canada, appear to have been under-estimated.

Dr Leigh says that while the link between white asbestos and asbestosis and lung cancer has been accepted for some time, the mesothelioma association has been more problematic and has been debated for 20 years.

His work involved a case-control study of lung tissue in 221 cases and 359 controls. These were part of 900 cases of mesothelioma, which have been notified to the Australian Mesothelioma Register. This is a much larger sample than in previous studies and allowed a multivariate analysis to reach a higher confidence level in the conclusion.

Fibres found in the lungs of sufferers were estimated for concentration and size distribution. The three types of fibres identified were:

- crocidolite (from blue asbestos – long, straight fibres which stay in the lung longer than those from white asbestos)
- chrysotile (from white asbestos – twisted fibres which are cleared from the lung faster)
- amosite (from brown asbestos – straight fibres which remain in the lung as long as crocidolite).

It has previously been shown that carcinogenicity (susceptibility to cancer) appears to be a function more of the geometry of the fibres than their composition.

The study was able to identify positively the types of asbestos to which sufferers were exposed. It found that a number had been exposed only to white asbestos. This form has continued to be used extensively as an essential component in brake linings and high pressure gaskets; and no satisfactory substitutes have yet been developed.

The research concluded that the risk of developing mesothelioma for each 10-fold increase in fibre concentrations in the lung increased 29.4 times for blue asbestos, 15.7 times for white asbestos and 2.3 times for brown asbestos.

However, Dr Leigh stressed that because white asbestos is cleared more quickly from the lungs, the carcinogenicity of chrysotile fibres inhaled relative to crocidolite cannot be readily deduced from these data.

To do this requires further work (now under way) to relate levels of white asbestos inhaled by mesothelioma sufferers to the actual number of fibres remaining in the lung at the time of death.

Explosives reveal Antarctic's warm history

American and Australian geologists have discovered fossils showing that three million years ago, the great southern continent of Antarctica was a startling 15-20 degrees warmer tand was largely flooded by rising seas.

Their study provides clues to the recent climatic history of the Earth and the new evidence suggests a cyclical warming and cooling. The present global warming, attributed to the Greenhouse effect, may therefore not be new.

McKELVEY

A spectacular view of the Dominion Range (2900 metres) overlooking th head of the Beardmore Glacier. Dr Barry McKlevey (left), and Dr Dan Green are pictured at a level about 300 metres above the centre of the glacier.

One of the excellent examples of the fossilised leaves found by the research team.

The expedition to the Beardmore Glacier was led by Professor Peter Webb of Ohio State University and included Dr Barrie McKelvey of the University of New England in Armidale, NSW.

Until recently, the prevailing theory has been that the great ice sheet covering 97 per cent of Antarctica was formed 15 million years ago at temperatures similar to those found today where glaciers emerge from the Great Ross Ice Shelf – minus 10 to minus 15 degrees Celsius – and has been permanent ever since. Now it appears the average temperature was as high as five degrees above zero in more recent geological time.

The first cracks were placed in the old theory when basically the same team found minute fossils in sediments high in the Transantarctic Mountains during expeditions in the 1980s. These fossils, including foraminifera and diatoms, had originally lived in a marine environment.

The fossil record allows the date of sedimentary rocks to be determined and, while many of them were clearly about 40 million years old (and consistent with the prevailing theory), Dr David Harwood, one of the team from the University of Nebraska, found some diatoms which were only 1.8 to 3.5 million years old.

The big question was how could they have got there. Sceptics unconvinced by the team's warming theory suggested that the microfossils had been carried far inland by wind or water from beyond Antarctica.

Then, on their 1985-86 expedition the team found samples of wood in the rocky Meyer Desert 2000 metres from sea level at the head of the Beardmore Glacier and only 400 km from the South Pole. The wood was similar to the Southern Beech tree Nothofagus gunni growing today in Tasmania.

However, the suggestion of a recent warm period was rejected by the sceptics who could not accept that the ice sheet had receded in recent times. They inferred the wood had been washed into the area or had come from older rocks and called for firmer evidence.

That evidence has been obtained by the team in the last Antarctic summer from the same strata of rocks near where the wood had previously been found. The rocks were very hard to break apart, but an expert in the team nudged them open with explosives. The bedding planes split and there, in profusion, were delicate fossilised leaves coming from the same tree as the wood samples.

Dr McKelvey said: "The leaves were remarkably intact and look as though they fell where they were found, probably in a pond or quiet backwater, and then covered." While the leaves themselves offer no evidence of the age of the deposits, the southern beech tree can only grow at an average temperature of about five degrees and the diatoms associated with them in the same strata give the age.

Dr McKelvey concludes that the ice sheet has been repeatedly expanding and contracting in response to major climatic changes. The valley containing Beardmore Glacier of today was probably once a fjord. The precious fossilised leaves are being studied by botanist Dr Robert Hill of the University of Tasmania.

Parallel computers show the way

Australian scientists have gained a competitive edge in computer control with the opening of two new supercomputers in Canberra.

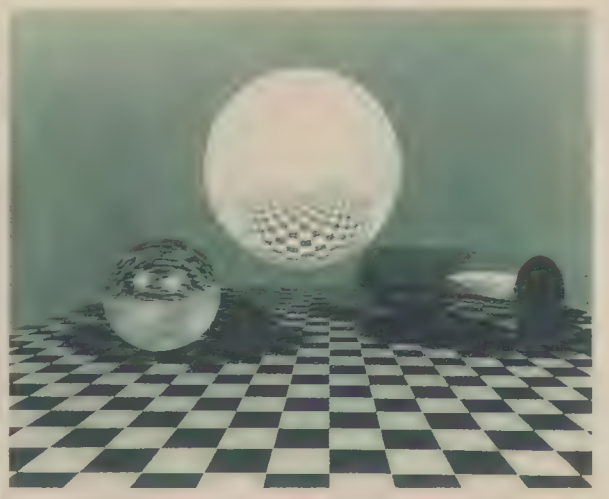
The value of the information industry in Australia alone is estimated to exceed $17 billion by 1995, but local industry cannot hope to match the US and Japan in the manufacture of mainframe computers. The great potential for local development lies in software and its profitable export.

Professor Michael McRobbie, Executive Director of the ANU's Centre for Information Science Research, says Canberra now has the most powerful collection of advanced computers in Australia and one of the very largest outside the US. The new machines – from DEC and MasPar in the US for CSIRO and from Fujitsu in Japan for ANU – will be linked together.

Computers work by doing the simplest of tasks very fast, sending electrons along paths which can be switched on or off. The longer the paths the electrons have to trace, the more time is taken for a calculation.

This is why miniaturisation became the name of the game and designers made the connections between the devices (transistors and the like) shorter and the switching speeds faster. Astonishing increases in calculation speed were achieved – down to billionths of a second in supercomputers.

And while new technologies, such as the use of light instead of electrical currents, hold promise of further improvements, eventually there is a physical barrier which miniaturisation cannot penetrate. The barrier is



A masterpiece of computer art – the first picture of imaginary objects generated by the ANU Fujistsu computer by drawing how light rays bounce off two spheres and a cylinder.

caused by the unavoidable fact that electrons and light can travel no faster than 300,000 km per second.

The revolutionary "architecture" employed in the two new computers is called "parallel processing". This involves building a computer from a large number of individual processors (one processor is the heart of the familiar desktop or laptop machine) and linking the separate "cells" together.

Up to 1024 separate cells are being used in the new machines. With cells working jointly, doing many more calculations in a given time, the parallel computers are thousands of times faster than a desktop.

The major challenge is control of the separate cells and researchers must develop unique software quite different to that used in the conventional "vector" computers in which work is processed down a single pipeline.

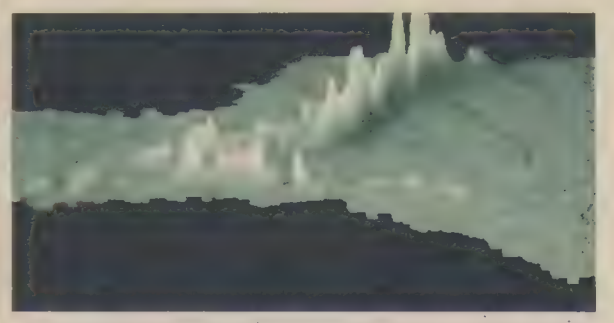
The ANU/Fujitsu deal for joint development of software is worth $10 million to ANU over five years. DEC/CSIRO collaboration is worth $1.5 million over three years and will support development of software by the Division of Information Technology for commercialisation and export by Australian information technology firms. The Fujitsu AP1000 is classed as experimental and ANU has the very first model in the world.

Professor Robin Stanton predicts exciting applications in visualisation – making pictures out of complex systems: "We shall be able to go inside objects to see how they behave, finding where there are high stresses in metals and where melting will occur.

"By calculating how light bounces off objects we can produce more realistic images, creating better pictures from medical imaging devices like CAT and ultrasound scans and helping doctors 'walk around' inside the body."

The CSIRO Division, based on the ANU campus, is using the new DEC MasPar MP1 computer to focus on spatial information systems. Already some images are being produced which are not only striking to look at but are useful in everyday business.

Dr Phil Robertson has shown how the computer can pull together huge volumes of data from satellites and ground-based mapping to produce pictures so fast that the operator can "fly around" and interact with them in real time.



Computer generated image from data collected by low-flying aircraft.

CSIRO software is being used in planning the most efficient use of farming land, in exploring for mineral resources to minimise expensive drilling, in electoral redistributions, in land title registers and in planning locations of public facilities such as telecommunications.

Peter Pockley is a science writer and broadcaster based in Sydney.

Solve our top ten woes

BARRY JONES

Paul Keating's use of the term Banana Republic has been quoted interminably in the past five years. We impose a disturbing self-limitation on ourselves. So many of our institutions and our capacity could be transformed from second rate to first rate with comparatively little effort. I can identify 10 major problems that need to be overcome if Australia is to fulfil its potential and make a serious contribution to solving world problems.

1. Lucky Country tradition. Australia had the apparent advantage of a very strong resource base. Historically when things were grim, "luck" helped us out (gold, oil, perhaps uranium). This resource abundance imposed serious psychological limitations. We felt that the resources were all we needed, apart from a tradition of improvisation (rather than inventiveness), stoicism and mateship in the bush. Until the Menzies-McEwen era the "lucky"/resource tradition seemed to be all we needed to keep us at the top in international tables of per capita GDP. It was odd that one of the world's most urban societies was so dependent on a non-urban economic base. The world changed, but we did not.

Only four countries outside the Third World have essentially the same exports now as they had 70 years ago: the USSR, Australia, New Zealand and Argentina. Three of the four are basket cases.

The turning point in modern economic history was 1957, the year when – for the first time ever – total world exports of manufactured goods exceeded exports of commodities. We failed to notice and maintained our traditional base. Some time early in the 21st century, services will pass manufactures as a proportion of total exports.

2. Derivative colonial model of industrial development. We gave up on making our own cars and trying to find international market niches. When the Americans and Japanese kindly offered to make cars for us, we were happy to agree. This prevented us from developing our own brands or styles and seeking to create our own reputation as reliable suppliers. The same phenomenon occurred with chemicals, electronics and many other areas in manufacturing.

It prevented development of a tradition of collaboration between research (universities, institutes of technology, CSIRO) and industry: industry relied on its overseas home base, and on the international pool of science and technology rather than interacting with local capacity. Our immature economic base also discouraged the development of industrial "clusters" which seem to be an essential precondition to significant development. Volvo does not exist in isolation, but interacts with electronics, metals, glass, paint and plastics industries.

3. Uncertainty about who we are: transplanted Poms? Asian neighbours? Multiculturals? Our symbols are confusing, too. The debate about making Australia a republic may clarify this.

4. Isolation: out of the historical mainstream. Wars aside, we are not greatly interested or involved about what is going on in the rest of the world. This makes us hard to recognise changes in the world market. We start off with what we are capable of making, rather than finding out what the world actually wants. We also have some sense of grievance that the world no longer owes us a living. We may once have benefited from isolation and the tyranny of distance, but not any more.

A certain autism running through Australian society makes it very difficult for us to understand how it feels to be an Aborigine (Koori), a Japanese, a Brazilian or an Indian, and to attempt to coming to terms with them on their ground. As Stephen Fitzgerald has pointed out, the number of Federal MPs fluent in an Asian language is 0, of department heads 0, university vice-chancellors 0, of managing directors 0. Where do we start?

5. Ambivalence about excellence/egalitarianism. Our robust anti-intellectualism, while less evident than 30 years ago, is the down-side of "mateship". Our State education departments are fiercely opposed to any kind of meritocracy, strongly committed to "equal outcomes" (but not in sport).

6. Impatience with complexity and the long-term. We yearn for a simple formula that works and we tend to reject the clever stuff. We seem unable to hold more than one big idea at a time. In the 1960s we put all our faith in protection + regulation + a managed currency. In 1991 we are totally committed to the free market (the celebrated but elusive level playing field) + deregulation + currency determined by foreign demand.

There is no economic debate in Australia worthy of the name. Treasury officers are like monks in a closed order where the theology is never challenged. There would be more chance of an agnostic in the College of Cardinals than a dissenter in the Industries Commission. There should have been a major debate on industry policy. It didn't happen.

7. Decline of Politics. Administration has now replaced or displaced the political process. The role of the Parliament is greatly diminished. Relatively little legislation arises from the political process, with a decisive contribution by Caucus or Parliamentary Committees. The political process has been substantially hijacked by the bureaucracy. Economic debate is virtually silenced because Government, Opposition and bureaucracy (notably Prime Minister and Cabinet, Treasury and Finance) have converged. A very narrow range of economic options is put to Ministers. The prevailing free market commitment has a quasi-theological fervour in the Canberra bureaucracy: it is asserted, as part of a creed, rather than argued out.

Issues barely count in election campaigns which make a lowest common denominator appeal to greed, fear, vested interest, sloganeering and leadership profiles. There is an increasing disparity between what happens in an election campaign and the three years in government that follows. The House of Representatives (and the Legislative Assembly) has become an Electoral College which certifies election of the Executive, then fades away except for increasingly theatrical set pieces such as Question Time. The value system on which parties were based historically are of decreasing relevance. Party membership is declining seriously for Labor, whose members – in the centenary year – see traditional positions being dismissed as sacred cows.

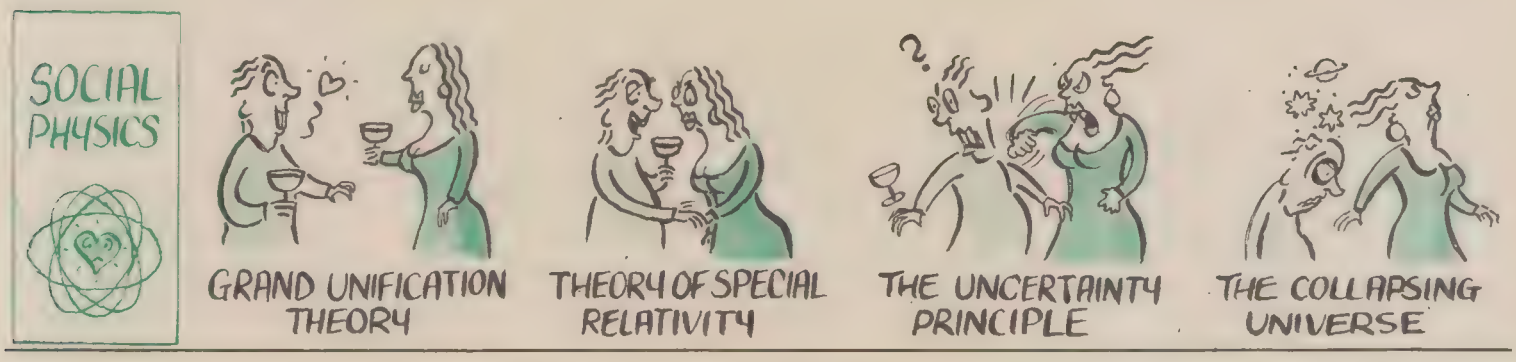
What roles do party members have now? Making policy? Not really, certainly not in Government. Choosing MPs; occasionally, but it is a rare treat. Fund raising? Yes, but the branch barbecue is of declining relevance in the age of the corporate bagman.

8. Short term collective memory. We have (sport aside) no pantheon of achievement. In a speech last year I remarked that Australians were "a bit dim". The press reports, via AAP, confirmed my point that we had a short-term collective memory by describing Evatt as a Prime Minister, Burnet as an electrical engineer and Monash as a Nobel Prize winner in Medicine because the subs in papers throughout Australia clearly did not know who they were, either. We don't worry too much about efficiency or competence: recent experiences in getting things repaired or mail delivered suggests that we don't fuss too much about getting things right. We simply do not understand how much the world has changed in the past 30 years and I detect a sense of grievance that the world no longer owes us a living. 'Letters to the Editor' exhibit an extraordinary ignorance. We are uncritical of ourselves and unfortunately we do not know how to start getting things right.

9. Easily discouraged. We give up, and can always pass on the blame for failure to somebody else. We are also easily satisfied, which means we tend not to worry much about getting things right.

10. Preoccupation with (short-term) materialism. We emphasise the material and short-term gratification. There are very high levels of consumption and little investment for the long term except in property. Value means "dollar value": the idea of non material values seems a contradiction in terms. The car becomes an extension of personality and encourages our tendency towards autism and narcissism. Our obsession with autoeroticism makes our huge cities extraordinarily inefficient.

DYSONETICS



INTERVIEW

Changes in the church

Anglican Archbishop Peter Hollingworth of Brisbane talks to NEXT

Given the general decline in Church attendances, how do you view the future of Christianity?

The general decline in attendances does not necessarily imply that people have become less religious. It is much more likely to do with modern, consumptive lifestyles and wider choices available to people in society. This means that the churches have to compete with other organisations for people's time and commitment. Meanwhile, more than 80 per cent of Australians still believe in God, although perhaps their understanding of matters of doctrine have now become somewhat hazy and confused.

Throughout the world all the major churches are involved in the Decade of Evangelism. This does not imply the traditional "big tent" evangelistic crusades of the past, but rather of encouraging lay people firstly to understand their own faith more fully, secondly to work out strategies for engaging others, and thirdly learning how to commend that faith in language that modern people can understand. If, in this decade, the churches are able to give a good account of their life and work and thereby persuade people of the importance of lively participation in local congregations, then the future looks very good indeed.

When it comes to social welfare, what do you see as the respective responsibilities of churches and governments?

Churches have always accepted what has been called "the welfare obligation" because it is a practical expression of the second Commandment, which is to love our neighbour as ourselves. The Churches and voluntary agencies in general will continue to make an important contribution to the care and support of the whole community. We have seen over the past 50 years the development of the welfare state, which means that government now takes more responsibility for the provision of finances and the setting of goals and priorities in welfare. Given that this is public money that is being spent on the welfare and support of people in need, this is the proper role for governments to exercise. Governments, however, have not had a good record in the actual delivery of services. Churches and voluntary agencies believe that they are better placed and come out of a stronger tradition of caring human values which is the essential basis for better quality of services, made more accessible to people and run at a lower cost. Sometimes governments can threaten that delicate partnership, especially if they believe it is politically expedient to take a higher profile themselves. This clearly requires continuing dialogue and careful negotiation between the partners.

What kind of special changes would you like to see implemented in Australian by the next century?

Australian society urgently requires transformation. We lack a vision for our future, just as we have failed to develop a distinctive role for ourselves in the region. The four axioms that I believe must be pursued are those of justice, sustainability, participation and efficiency. You can't have one without the others, and the challenge for us in bringing about change is to move in all four directions in a balance and integrated way. There will always be tensions and competing priorities but we need not be afraid of these, provided we are able to develop more effective skills in conflict resolution. If more Australians were much clearer about where they should be going in the future, there would be much less difficulty in resolving some of these tensions. Where we ought to be heading is a matter which should come out of our values. These have not been given the attention they require.

Archbishop Peter Hollingworth

Do you foresee a time when a woman will be an Archbishop? How long will it be before women have the same kind of representation in the Church as in other walks of life?

I do foresee a time when a woman will be an Archbishop and, indeed, there are already two women bishops in the Anglican Communion. Of course it depends upon which particular branch of the Church you are talking about because each denomination has very different traditions and doctrinal positions. It will be much more different for the patriarchally led Orthodox churches of the east, somewhat less difficult for the Roman Communion while the Anglican Church is already on its way. The Free churches mostly have already ordained women as ministers. So you can see that there is a wide diversity of practice throughout the Christian world. Over the past decade we have seen a remarkable transformation with regard to representation of women in leadership positions. These days the Synods, or parliaments, of the Church are close to a 50 per cent gender balance and people are more conscious of ensuring that women are selected to the councils and decision-making bodies. They have, of course, always exercised a crucial role in local congregations, working quietly behind the scenes and effectively making decisions. As in other things, women have adopted traditionally a more informal role of leadership. Now that they are taking formal positions, there are significant changes taking place in the Church and its methods of decision making. All that I regard as a most desirable thing.

Should Church leaders address environmental issues and, if so, in what way?

I believe very deeply that a right understanding of the creation and of a loving Creator who left the world in the hands of his people as stewards means a very deep commitment to the environment and the ecosystem. In the past few years, the Churches have been reviewing their commitment to the doctrine of God the Creator and the Creation. This has inevitably led to a much deeper commitment to conservation and environmental matters. Last year a major national study was done by the Anglican Church under the auspices of the Diocese of Perth and a very fine report was produced called Justice for the Earth. The big task now is to help our people to see that there is a quite distinctive tradition about environment commitment which comes out of the book of Genesis itself, and of our task of being good stewards of what we hold in trust. It is true as well that one of the other traditions in the Genesis myth has talked about "subduing the earth" but I don't think that anyone ever envisaged this to mean that we could do whatever we liked with it. In conclusion, I believe that Christians and other religious groups will in future play their part with other people of goodwill in the great task of ensuring the survival of our planet.

Testing time for the fishing industry

A new Australian survey will help fish consumers everywhere determine whether their catch is fit to eat. The National Residues Survey (NRS) being conducted by the Bureau of Rural Resources is now casting its net over Australia's fishing industry. A pilot NRS monitoring program is underway to establish the sampling and analytical methodology for the formal survey set to begin as early as mid-1992. It is the first time anywhere in the world that a national fishing industry has been subject to such a program. The NRS aims to guarantee the safety and quality of export fish, but local market fish and imported varieties are a long-term target. The NRS has significance in trade terms following the scandal of high traces of organochlorine pesticides found in Australian beef being exported a few years ago to the US.

Prawns in sawdust: a new and efficient way of exporting. Australia's threatened fish: page 93.

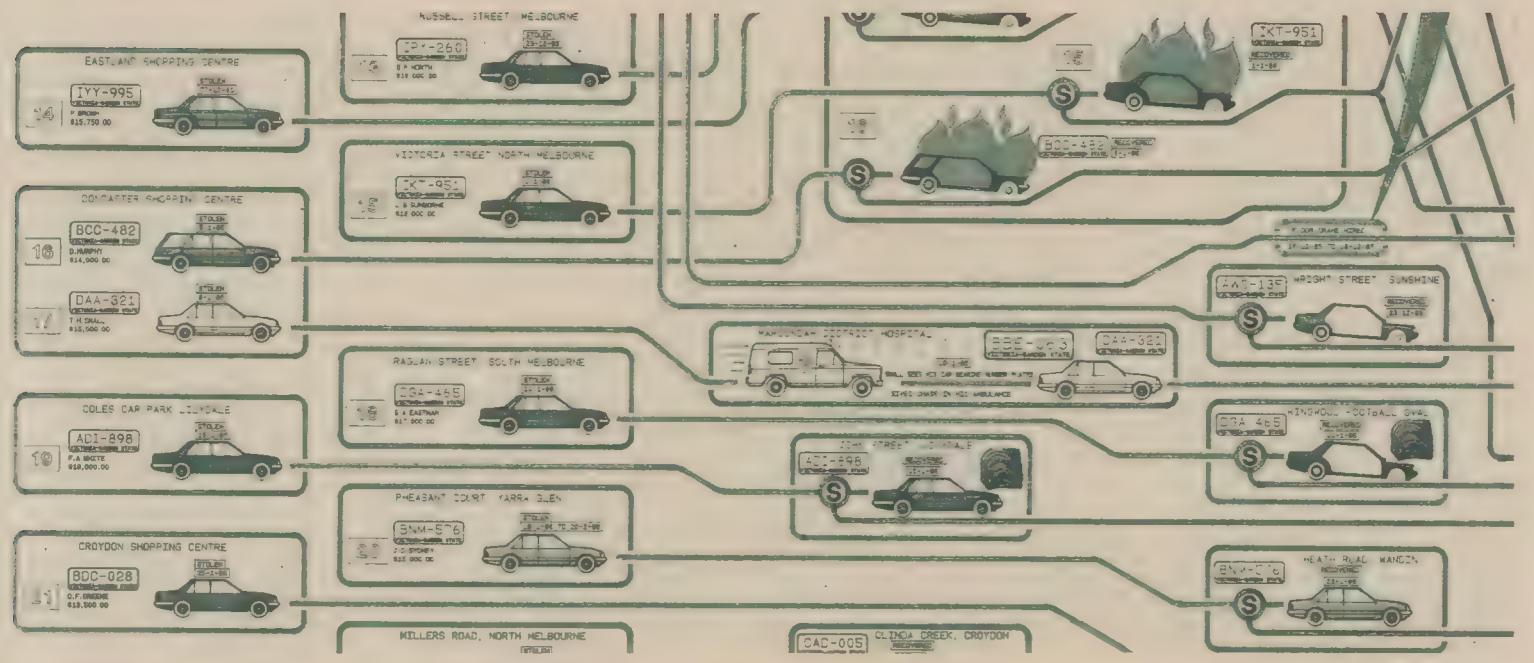
Although the NRS is good news for consumers, fishermen are suspicious of any increase in scientific scrutiny. They claim data is difficult to obtain from State authorities and are wary of scientific studies being used by governments to simply close "polluted" fisheries instead of tackling the pollution source. So sensitive is the industry that Queensland's Professional Fishermens Association has put a five-year embargo on publication of the results of its own study. Too often the victims of other industries' filth, some fishermen may push to have the pesticide and chemical industries pay a levy on NRS research.

The NRS may also be a useful source of data for environmental agencies which may need to distinguish between residues resulting from human activity and those which naturally occur in high concentrations, such as cadmium, mercury and arsenic.

In another positive move to raise the standard and uniformity of Australian foods, including fish, some functions of the NH&MRC have been absorbed by the newly created Interim National Food Authority. The association will be responsible for the National Market Basket Survey and will set permissible levels of "incidental contamination by heavy metals" in Australian foods. For fish, "incidental contamination" may occur when heavy metals and chemicals reach the seabed from river runoff or urban waste disposal. The NH&MRC will continue to set maximum residue limits for pesticides and agricultural chemicals deliberately introduced into the environment by permitted use such as crop protection, fertilisation or grain storage. The NFA will set a "contamination level" for a residue based on what are termed "provisional tolerable [human] weekly intakes." These are based on recommendations of the World Health Organisation and Food and Agriculture Organisation, and the Joint Expert Committee on Food Additives and Contaminants, which has Australian representation.

VIVIAN CARROLL

AUSTRALIAN INNOVATION



A detail from the vehicle theft chart which explained complicated information.

From silks to software

The tedious, drawn-out wafflings of lawyers and slow court procedures are likely to become less prevalent with the arrival of computer-aided court presentations, a concept unique to Australia and developed in Melbourne by Robert J. Perry and Associates.

Robert Perry first hit upon the idea in 1984 when he served as a senior detective with the Victoria Police. He was working on a case which involved the theft of 130 vehicles. Realising that the court had difficulty keeping track of the thefts, he drew up a large diagram showing the cars' histories, who had stolen them and how they'd been resold. His design and drafting skills enabled a detailed and messy legal brief to become a series of clear pictorial diagrams which the resident judge commended as "a remarkable production".

Mr Perry has always seen the rich possibilities for a business specialising in computer aided court presentation and investigation management. He left the police force to form his own company with Don Lines, a former senior sergeant, and computer specialist Tony Bell.

Their concept is ingeniously simple and requires no computer knowledge by a client. A brief is handed over to the firm by the lawyer and examined thoroughly over a period of up to two weeks. Once "visualised," a quote is submitted, and the entire legal brief is painstakingly translated into a series of simple images and incorporated into a one-page draft.

Using computer-aided drafting (CAD) and Qikdraw software, stock symbols (such as cars, people and buildings) are kept on file, while other symbols (such as a particular type of weapon) are tailored to the specific needs of a case. The client then checks the draft, with any necessary alterations being made very quickly, and multiple copies are made for the jury and other relevant people.

The beauty of computer-aided court presentation is that as well as the methodical and speedy nature of its assimilation, it is also flexible and can render even the most complicated cases pertinent and easy to comprehend. There's no need for pre-trial negotiations, lengthy explanations or Geoffrey Robertson-like pirouettings because a summary of the evidence is there before the court in clear and pictorial form.

As Tony Bell says, "We all think in pictures. What computer-aided court presentation does is to cut through the verbage and preamble, and come up with the guts of the situation in a way that everyone can understand." Accordingly, the charts can illustrate complex issues, ranging from criminal charges and civil litigation to insurance fraud, white-collar rackets and taxation disputes. They can also map the loopholes and inconsistencies in the evidence.

In a case recently where a bank robber pleaded guilty to only six of 19 charges (thinking the court could not prove the other 13), Robert J . Perry and Associates drew up a diagram showing just how the charges could be proved. The robber consequently pleaded guilty to all charges, eliminating the need for a jury and enabling the hearing to run for only four days instead of the planned three months.

"On average, hearings can be reduced by about 75 per cent," says Tony Bell. "We can't put anything in the chart which is prejudicial, of course, such as showing in a murder case an axe covered in blood. We just clarify the evidence, and if facts change, we alter the diagrams immediately. We never handle both sides of a case."

The potential benefits of computer-aided court presentation are enormous. The charts' costs are minimal, ranging from under $1000 to more for top-level work - far less than the price of a senior barrister for one day in court. The technique saves on public and client expenditure, bridges the communications gap between barristers, solicitors and clients, and reduces the need for juries and court hearings.

Already Robert J. Perry and Associates numbers among its clients the Commonwealth Director of Public Prosecution, the Australian Securities Commission, the Federal Police, Melbourne law firms and the National Crime Authority.

As a solution to the problems of the high cost of justice, Computer Aided Court Presentation is visionary and eminently practical, making access to the law easier. And certainly, for the smart would-be Rumpoles, the concept could mean winning more cases.

JULIETTE BRODSKY

FUTURE BOOKS

A decade of fundamental change

"The 1990s will require an entirely new perspective, new strategies, and new skills because the decade ahead promises to be far different from the one just past," says financial writer Gary Klott in his book, The Complete Financial Guide to the 1990s.

"American business and society are being transformed in fundamental ways. The occupations, investments, and businesses that offer the best opportunities will be different from those of the past."

Among the trends Klott examines:

- Flexitime, job-sharing and working from home will become far more common in the 1990s.
- Technological advances, ranging from biotechnology and space-age materials to superconductivity, will bring about profound changes in our lives, and will provide exciting opportunities for investors.
- The middle-ageing of the baby boom generation, the growing impact of working women, and the shrinking number of young adults will bring about major changes in the workforce.
- Traffic congestion will continue to worsen, making commuting a nightmare and affecting a range of issues, from work schedules to property values.
- A growing awareness of environmental problems and our subsequent efforts to clean up toxic wastes and reduce atmospheric pollution "will cost consumers and businesses many billions of dollars and impact on many facets of life."

The Complete Financial Guide to the 1990s by Gary L Klott (Times Books/Random House) US$22.50. Available from The Futurist Bookstore, World Future Society, 4916 Saint Elmo Avenue, Bethesda, Maryland 20814, US.

Dish probes deeper

BY PETER POCKLEY

The ultimate observatory for radio astronomy will be established in three to four years when 30 ground-based dishes throughout the world, including several in Australia, are linked with two orbiting radio dishes. Space VLBI, as it is known, will come into action when the Soviets launch Radioastron in 1994 and the Japanese send VSOP up in 1995.

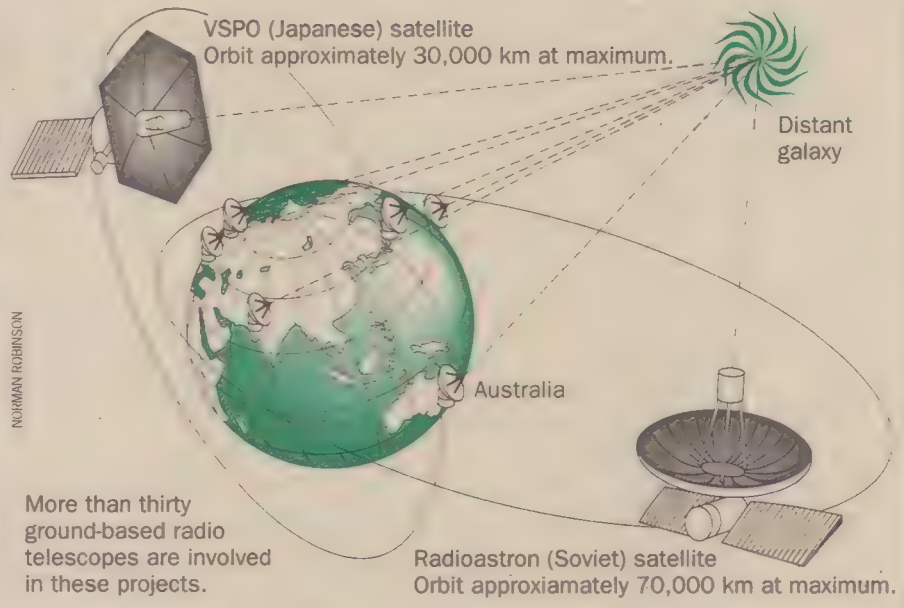
When Radioastron is linked to the Earth-bound network, simulating a single dish up to 80,000 km across, it will almost certainly form the largest possible telescope for radio astronomy. The ambitious project to probe deep into the universe took a major step forward recently at a meeting in Sydney.

VLBI stands for Very Long Baseline Interferometry, an electronic technique already well tried and used on earth to overcome the physical limitations on the size of single, steerable dishes. The larger the distance between the telescopes when signals are combined, the greater the detail that can be "resolved" by interferometry. But even the detail obtained with a simulated dish several thousand kilometres across (as when radiotelescopes are linked across the oceans) is insufficient for astronomers to probe the innermost secrets of the galaxies and quasars which are the main emitters of radio waves in the universe.

The Radioastron satellite will follow an elongated elliptical track 5000 to 80,000 km from Earth. The VSOP satellite's path will be more nearly circular, 20,000 to 30,000 km away. VSOP is named not after the finest brandy but for VLBI Space Observatory Program.

Objects visible only from the Southern Hemisphere will largely be covered by Australian telescopes, led by the Australia Telescope which was commissioned last year as a network of eight dishes spread over 320 km in NSW, including the 64-metre Parkes dish. Dishes at Tidbinbilla in the ACT. Hobart and Perth will also join in.

Large radiotelescopes in the Northern Hemisphere network will include Jodrell Bank in Britain, Germany, the Netherlands, mainland US, Hawaii, Japan and Soviet Central Asia. Professor Nikolai Kardashev, who heads the Space VLBI team at Moscow's Astro Space Centre, said that finance for the Radioastron project had been guaranteed through the Soviet Academy of Science and he did not expect the USSR's economic difficulties to cause delay. The Soviets have even scheduled a second Radioastron launch if the first is successful.



HOW THE SPACE VLBI WORKS

Dr David Jauncey, of the Australia Telescope, says astronomers will first use Space VLBI to study the 40 most energetic radio sources in the universe. An early observing target for the system in the Southern Hemisphere will be the spectacular Centaurus-A, the nearest of the active radiogalaxies, 15 million light years away. Space VLBI will see right into its nucleus and identify objects the size of the solar system (eight light hours across).

If all goes well, Dr Jauncey believes Radioastron will provide detail one thousand times sharper than the Hubble Space telescope was designed to achieve. In the Northern sky some quasars will be studied early by the network. The search for black holes, as the likely source of the immense energies emitted by such quasars, will be aided by the great detail possible through the system.

However, Space VLBI will not make ground-based radiotelescopes obsolete. The small size of the orbiting dishes mean they cannot rival the much greater sensitivity of large steerable dishes on Earth. The satellite dishes, each 10 metres across, will be formed after going into orbit by uncurling a folded structure like the petals of a flower opening to the sun.

The Japanese are building all of their equipment, including three receivers for detecting signals from space at different wavelengths. The VSOP-Earth system will provide the better pictures, while the Radioastron-Earth link will yield the more detail. Radioastron is using four receivers built in Australia, Finland, the Netherlands and India. The Radioastron receivers are well advanced and engineering models will be delivered to Moscow in September for the first round of "shake, rattle and roll tests."

The Australian contribution is a national project costing $1.3 million, provided by the Australian Space Office (2/3rds) and the CSIRO Space Office (1/3rd), both Canberra-based. British Aerospace Australia in Adelaide is the prime contractor and Mitec Australia in Brisbane is building many of the components. The massive and complex international coordination involved in the Space VLBI program was the focus of the Sydney meeting. A Global Working Group was set up to coordinate the ground-based VLBI network with the space missions.

As well as linking existing radiotelescopes together, the project requires a global network of new ground-based receivers to gather the signals from Radioastron and VSOP. At a cost of $US40 m, NASA will be installing 10-metre dishes at Tidbinbilla, Madrid, California, Eastern US, USSR and Japan. There is a formidable job in coordinating all the data transfer between telescopes. Signals will be recorded on high-speed videotape for later combination at correlation centres to form TV-like pictures of the objects being observed. Five centres will be established in Europe (probably in the Netherlands), US, USSR, Japan and Australia.

The total cost of the Space VLBI project is hard to estimate but the Soviet SPECTRE missions, of which Radioastron is a part, were costed in 1990 at 450 million roubles each. The VSOP satellite will cost $US80m and the rocket launch another $US80m. Correlation centres will cost from $US10-27 m, according to size. Dr Kelvin Wellington of the CSIRO Division of Radiophysics, who heads the Australian engineering effort and cooperation with the Soviets, says the preparations are going smoothly and are on schedule.

The Australian involvement with the Soviets is the first fruit of a bilateral science agreement settled between the two nations after Prime Minister Bob Hawke visited Moscow in 1987.

Dr Pockley writes on science from Sydney.

Five antennas of the Australia Telescope, near Narrabri, New South Wales.

Faith Popcorn's glory gaze

Here's my prediction for the 1990s: the growth industry will be trend-spotting. If you have teenage children with no career prospects, apprentice them to a firm of futurologists and you can look forward to a well-supported senility. During a short visit to New York recently, I encountered two people who are benefitting from America's current passion to know its future – Christian Gilbert and Faith Popcorn. Gilbert runs a small firm called TFS (which stands for The Fashion Service), advising makers of clothes, cars and toys on the colours and styles that buyers will soon crave.

Popcorn runs a big firm called BrainReserve, advising clients such as American Express, Eastman Kodak, IBM, Coca-Cola, and Philip Morris on how they can create or adapt products to meet the mood of the populace. Popcorn is not her real name, incidentally. She was born Faith Plotkin, but changed it because she thought Popcorn would be more memorable. That was her first successful prediction.

Gilbert and Popcorn are two examples of the trendwatch boom now resounding through American business. Hundreds of operations like theirs have started in the past five years, sometimes as units within advertising agencies or PR firms or universities, more often out on their own. They trace their ancestry not to Nostradamus or the Oracle at Delphi, but to pop sociologists like Alvin Toffler, who became seriously rich in the late 1970s by putting the phrase "Future Shock" into the language, and John Naisbitt, who has sold eight million copies of a book called Megatrends since 1982.

DAVID DALE

When I interviewed Christian Gilbert in New York, he was wearing a bright green blazer, baggy trousers, pointy cowboy boots, a flattop haircut and a big gold ring in one ear. He says some clients find his look intimidating, but most expect him to be on the cutting edge of style. He trained as a chef, then went into an advertising agency before deciding that the big bucks would be in telling companies how to prepare for the Next Wave. His clients pay a base rate of $10,000 a year to receive regular packages of information on the latest fads in colour, cut, fabric and social life.

Gilbert sees the '90s as a period in which greater value will be placed on softness, caring and individuality. "We refer to the '80s as the Dynasty Decade – rather excessive, greedy, symbolised by the Reagans in their flash soap opera style," he says. "The '90s will be more basic, more grassroots. Hopefully we are not going to give up the freedoms we've earned, but it has a more conservative feel. We're very interested in nature, in texture, in organic things. Water is a strong image – wet surfaces, blues and greens."

Successful trend-spotters are required to coin phrases, even if that means restating the obvious in jargon. Faith Popcorn's top concept is "cocooning", which she invented in the mid-80s. It means that people find the world so complex and alarming that they just want to stay home and surround themselves with comforts. Popcorn predicted that this would mean a growth in video rentals, takeaway food, shopping by phone or mail, and home delivery of products, with a simultaneous decline in attendances at restaurants,cinemas, nightclubs and sporting fixtures. She seems to have been right.

This is how her company does its research: "We interview 3000 customers every year, looking for patterns, directions. We have readers who absorb about 3000 publications a year, we watch television, we go to the movies, and we have what we call our TalentBank, made up of the kind of people you meet at a party and afterwards wish you'd spent more time with. They include doctors, lawyers, farmers, even an Indian chief. When we get an assignment, let's say come up with a new food, we get our TalentBank together in groups of 12 or 15 and we brainstorm."

Popcorn already has a label for the '90s: the Decency Decade. It will be a time, she says, when individuals can make a difference. "People are looking for real products, real services, real heroes," she says, "and there will be a resurgence of social activism." She predicts that "vigilante customers" will successfully put pressure on companies to behave more ethically and more ecologically. It has already started – there are 200 boycotts underway in America against products deemed to be socially damaging, and now you can even subscribe to a "boycott newsletter" to find out what you shouldn't be buying this week.

I asked Popcorn and Gilbert if they had any predictions about how Australia might fit into the mood of the '90s. It was apparent that neither had considered the question before, but that did not deter them. Gilbert said that the image of Australia was relaxed, casual and associated with sun and surf, which are precisely the qualities he is telling his American fashion clients to capitalise on for next year. He says the fashion and lifestyle trendsetters for the near future will be California, Florida and, now that he thinks about it, Australia.

Popcorn offered this analysis: "Americans still think Australia is wonderful. It seems like the perfect place to be. Eco-tourism is the new way to travel. People are looking for a quiet place, a place of beautiful natural things. Isn't that Australia?" So there we have some good news from two people whose livelihood depends on knowing how things will be.

And the great advantage in making a career as a trend-spotter is that you are rarely held to account when your predictions fail to eventuate. Operators like Gilbert and Popcorn can always talk their way out of it by pointing to a new factor which changed the equation. To be a fortune teller in the modern business world, you don't necessarily need crystals, but you do need balls.

David Dale is a Sydney broadcaster and the author of The Obsessive Traveller or Why I Don't Steal Towels from Great Hotels Any More. (Angus & Robertson.)

Time to listen with respect

Paul Briggs of the Koori Resource and Information Centre announces an important new project

White Australia has culturally influenced the way of dealing with the social and economic problems that we face as a nation. We often hear the views of individuals, the scientific fraternity and environmentalists on the future of Australia. These views have been sought, or are encouraged, in an environment conducive to respect.

Western culture's denigration and abuse of the social and environmental stability of Australia emphasises the need to respect the alternative value system that emerged and grew with the prevailing environmental conditions before the invasion of Australia in 1788.

In this project, the Commission for the Future is encouraging Koori views to be shared in a supportive environment. Whether Koori communities accept this as more than a token gesture, and whether Australians are ready to listen with respect to Koori vision, has yet to be determined. History demonstrates that this has not been the case so far.

Recognising the importance of Koori vision, the Commission for the Future is attempting to gauge the interest of Aboriginal communities, groups and individuals in the hope they can use commission resources to develop and present Koori views of the social and economic future, both as it relates to our people and across a broad spectrum of other issues. This project would also indicate the strategies Koori people see as important in achieving that vision.

We rely on the courage and determination of Koori people, against some pretty fearsome odds, to always pursue recognition of basic human rights and to erase the present inequalities. The project will develop over approximately four years. The first year will concentrate on research, consultations, and the development and reaffirming of guidelines.

The project will be contained in its infancy to Victoria and Tasmania, primarily so a concise consultative approach can be developed before expansion to other States. The first 12 months will require the establishment of a development team of four to six people with varying degrees of expertise in Koori affairs, some supported by academic backgrounds, all with a long history of political and community involvement. They will be supported by a full-time secretariat consisting of a co-ordinator plus administrative aid.

This team will actively seek the vision of prominent Koori individuals and community perspectives across Australia to create the platform from which to launch a national project. The process will be documented from its commencement to its completion. There will be an intense consultative approach, with findings and outcomes carried back to their source for confirmation and endorsement. The visions of Koori people presented in this project will be used, with the permission of their source, to present to Black and White Australians a perception of Australia's future as visualised by the Koori people of Australia. The information will provide Australia with alternative and challenging visions of the future. It may also form part of the cultural literature, visual and performing arts of Australia. It will assist in promoting cultural awareness, diversity and understanding among Australian communities.

In looking to the future and establishing a long-term vision for Australia, the input of Koori Australia cannot be underestimated. We believe that we are one cornerstone of a developing culture that will lead Australia out of this era of uncertainty and apparent lack of cultural direction towards a much brighter and secure collaborative 21st century.

Name for a nation

Koori is the term used by Aboriginal people in lower NSW, Victoria and Tasmania. Other States have different words to identify themselves ie Murrie (NSW, Queensland), Nunga (SA), but Koori appears to be gaining national acceptance.

Merlin's new apprentices

BY MURIEL COOPER

Imagine, in Merlin's day, being able to create lightning at will AND cage it. That's just one of the magical sights at the National Science and Technology Centre in Canberra, where the modern Merlin, Dr Michael Gore, Director of the Centre, puts on shows which hold audiences spellbound. It's possible to experiment with the first robotic microscopes in Australia, watch electrical discharges shoot metres into the air in the force gallery and be fascinated by the spidery, ethereal light of a plasma ball.

Questacon's Shell Science Circus, a travelling roadshow, and Starlab, a portable planetarium which transports you to the depths of the universe, are just two engaging projects designed to interest the young in science.

The National Science Museum is not the only organisation bringing science to people, particularly students, in this way. Hundreds of dedicated people all over Australia, Government and privately funded, are providing similar centres.

The CSIRO has science education centres providing wonderful services to students. The Science Education Officer in Melbourne, Andrea Horvath, explained: "We provide kids here with what they can't do in schools, hands on equipment like bar-coding machines to show them how they work, or equipment using optic fibres. We like to run a regular science show, for example one we did was called Be a Kitchen Professor talking about how science works in the home, with experiments they might be able to reproduce at home."

There's a Women in Science program in which women scientists talk to groups of female students and Andrea is always looking for other programs and activities. "I try to develop programs in which science overlaps with language, art and life," she says.

The CSIRO Education Centres vary from state to state. Tasmania's centre is small but active. In Sydney, the centre is located in parkland and caters for a much larger number. While some visitors are catered for inside the centre, others are outside in the parkland concentrating on natural sciences. There's the new SciTech Museum in Perth and the Adelaide centre moves soon to the new "investigator" science centre.

On a more practical level, there's the CSIRO Student Research Scheme, a program which allows selected senior secondary students to participate in current scientific research under the supervision of practising scientists. This year, 150 students are involved and are expected to take their project back to the classroom.

The CSIRO Double Helix Club is another way of getting the message across to students in a fun way, with a magazine, regular excursions, competitions and activities and well-designed merchandise.

The John Gardiner Centre in Melbourne at John Gardiner High School is supported by various organisations including Swinburne Institute of Technology and College of TAFE, and the Victorian Government. Everyone who's taken part in their programs raves about their entertaining and educational activities.

There's the children's museum in Victoria, museums all over Australia, and the Swinburne Science Shop in Melbourne.

All these centres have several things in common: they are dedicated to promoting a greater awareness and understanding of science and technology and enthusing students to include these subjects in their study courses. They give "hands-on" experiences which teachers find impossible to provide in the classroom. They set up support programs for the teachers themselves, providing curriculum support and activity ideas. Most of them also like to provide activities the whole family can enjoy.

They also have in common (even the National Science Centre in Canberra) a shortage of money. Funds, it seems, are a constant problem. At the CSIRO Education Centre in Melbourne, the Education Ministry cut funds, including those for a full-time teacher. After a spirited campaign, the teacher was restored, but funding cuts still mean a lack of support staff.

Inside these centres OUTSIDE the classroom, young people are finding science exciting, entertaining and challenging. People and organisations dedicated to encouraging youth to be interested in the sciences are doing a great job. But does that interest and enthusiasm exist IN the classroom?.

One teacher said many primary teachers shy away from teaching science because they feel intimidated. If they have not taken straight sciences at tertiary level science classes can often be messy and embarrassing.

There ARE many primary teachers who are dedicated to making in-school science classes as exciting as those offered by special outside centres. One of them is Jane Morrison, science co-ordinator of the junior school at Presbyterian Ladies College in Melbourne. Jane has just written a book aimed at primary school teachers intimidated by science classes. The exercises are fun and use easily accessible equipment.

Jane's book *Renewable Power* will be available soon. It concentrates on a series of experiments which show the wind, sun and water as sources of renewable energy. One, for example, shows how to build a windmill. It is, says Jane, "like a science experiment recipe book." She emphasises something which was another common opinion among the science teaching community, that science should be integrated into the curriculum, not isolated. This opinion is shared by Bob Greaves, senior lecturer in early childhood and primary education at Monash University. He believes that subjects like science and art should be integrated to promote greater creativity and self esteem.

There is cause for pessimism however. Geoff Snowdon, section head of the education programmes section of the National Science Centre, says it's important to raise self-esteem of science teachers. Geoff says: "Teachers are doing their best, but we need to set up a program to extend the experience to teachers so that they can provide young people with a lot more confidence in science."

WHAT'S NEW

➢ A new video camera about the size of a stamp can be made for less than $50. Researchers at Edinburgh University have integrated an image sensor with other camera electronics on a single silicon chip, on which a tiny lens can be attached. The new camera makes possible the development of an inexpensive video telephone.

➢ **Miniature heads of iceberg lettuce developed by US Department of Agriculture researchers may be ready tor trendy diners by 1993. As crisp and tasty as regular iceberg lettuce but only the size of a tennis ball, the midget lettuce is ideal for single service salads or for people who simply can't finish a whole head while it's still fresh.**

➢ The world's first full-colour desktop fax machine has been produced by Sharp Electronics. But it's a heavyweight in more ways than one: The FO-9000, which provides near-perfect reproduction and can share with conventional fax machines by bypassing black and white calls, weighs more than 30 kilos. And the price: US$32,000.

➢ **A Seattle company is producing cotton T-shirts, sweatshirts and shorts that change colour in reaction to bodyheat. The secret Japanese dyeing process produces clothing in which blue turns pink, green turns yellow, purple turns blue, beginning with hotspots like armpits and neckline. So if you blush easily, save the US$24 asking price.**

➢ Goodbye to gooey melting drips. Just out in America is Hershey's Desert Bar, a chocolate that can withstand temperatures up to 140 degrees (conventional bars start to liquefy at 78 degrees). The new bar was first produced last year for troops in the Middle East. And taste? It's not the mother of all bars, but passable.

➢ **Sharp has also produced a pocket-sized fax that can send messages, but cannot receive them. The attachment is designed to work with the Sharp Wizard pocket organiser.**

➢ Busy people who don't have time to pick up their groceries may be the first customers for refrigerated mailboxes. A US retailing consultancy predicts that stores could regularly deliver orders along routes and leave the food in private refrigerated lock boxes that shut automatically, to be opened only by a coded plastic card when the householder returns home.

➢ **A walking robot will soon be performing leak detection and maintenance inside a French nuclear power plant. The six-legged Odex III, designed by Odetics, Inc., can carry television cameras and heavy equipment and move on uneven surfaces, such as stairs. The robot will be able to observe and report plant conditions, clean up, and do repair work in environments hazardous to human workers, according to the manufacturer.**

➢ Britain may one day import most of its power from Iceland. Hydroelectric and geothermal power plants in Iceland could produce electricity cheaply and cleanly, then export it, says Tom Hammons, an electrical engineer at Glasgow University.

His plan, now technically feasible, would involve laying the world's longest undersea power cable between Iceland and the north of Scotland.

➢ **Computer maps are on the way. The US Canada, Britain and Australia are combining to produce the Digital Chart of the World, which next year will allow users to zoom in and out of countries and cities at a scale of 1: 1 million. Planners and generals are expected to derive most benefit.**

Sources: THE FUTURIST THE CHRISTIAN SCIENCE MONITOR FORTUNE WORLD PRESS PREVIEW US NEWS & WORLD REPORT

Gadget greed's ghosts

Spin your mind a thousand years into the future when our sophisticated society is dead and buried. You the archaeologist are working on a dig to uncover the secrets of a tribe which flourished in the late 1900s. What will you discover as you dig down, down beneath the musty layers of McDonalds wrappers, newspaper liftouts on deforestation and rotting Bart Simpson T-shirts? That here was a group of regular fun guys who liked a good time, certainly.

But what will you deduce from the vast piles of domestic techno-junk you find in every humble abode? The CD players and stereos with digital readouts and graphic equalisers, the video recorders with automatic timers, still-frame buttons and remote controls; the telephone systems with automatic redial and paging functions. You may assume that here was a highly adroit tribe who were skilled in handling complex technology. And you will be be dead wrong. In fact, unless you are very thorough you will overlook the one real clue which will tell you more about the technical competence of this tribe than any other single item in this steaming pile of non-biodegradable garbage. Look at the instructions on the packet of Kraft cheese single slices. They will say : "A: Remove wrapper from cheese. B: Insert in mouth." Now here's a puzzle to stump even the most learned archeaologist.

WENDY HARMER

How will you explain a tribe which sent the Hubble telescope to gaze on the plains of Mars yet needed instructions on a box of matches? A civilisation which could perform laser surgery on a foetus in the womb yet needed road signs which read: "Form two lanes"? A society which split the atom yet put serving suggestions on cans of baked beans. The correct assumption will be that here lived the greatest bunch of techno-clods that ever bumbled their way into the universe. Let's face it, most human beings reached their peak of understanding of technology in Ancient Egypt. In those days, most of us understood that if you hit things with a stick they broke, if you put a flame under them they burnt and if you pushed them they moved. A certain elite were acquainted with the principles of the pulley and the lever, but these boffins were considered the brains of the outfit. By the time the button, the dial and the switch came on the scene, the majority of the population had totally lost the plot. In fact as the 20th century draws to a close, 99.9 per cent of human beings cannot explain the scientific principle behind even the most humble of human inventions. Ask most folk to explain how a toaster works and they will be dumbfounded . . . and I'm talking pre pop-up here.

"Um, well, the toast goes in the toaster and electricity comes in from a wire, which you plug into the wall and it cooks the toast." Currents, filaments, wattage, ampage . . . no idea. Silicon chips, programs, bytes, laser discs, memory . . . you've lost me. Rocks, sticks, flames . . . I may just about be able to help you on this one.

Yet the demand for sticks and rocks has fallen considerably through the ages while the demand for the digital readout rages unabated. We have lost the desire to know how things work. The farmer working with the stump jump plow knew more than us. Yet we believe that by merely owning technology we are smart, and the more sophisticated the technology the smarter we feel.

We've come down with a bad case of gadget greed. These days we want watches that add up; radios that make coffee; televisions that tell the time; and microwave ovens that talk to us. Not only do we demand that our technology is multifunctional, we also demand that it is completely portable. Not only can we use our gadgets for uses they were never intended to have, but we can also take them places they were never intended to go. And when they don't work, we fall back on what we do know . . . we hit them with a stick. Of course there's no denying that technology has made our lives easier . . . the telephone, now there's a marvellous invention. How on Earth they get the voice into those little wires is beyond me.

But I have really enjoyed my telephone. So how much more enjoyment will I get from a portable telephone. What a boon it has been! Before I had my portable telephone, if I wanted to take a shower I would have to go through the sheer drudgery of taking the phone off the hook or switching on the answering machine. Now I can enjoy all the benefits of getting out of the shower dripping wet to answer the telephone which is resting most conveniently on the vanity unit. No more uninterrupted showers! How smart am I? You detect a note of cynicism here. My pocket-size portable telephone is the light fibre straw which has broken the cyber camel's back. I give up, technology is ruining my life.

It began with the video recorder. I just can't work it. I now humbly accept I will never come within cooee of knowing how this remarkable technology works, but I would like to be able to grasp the concept behind the knobs on the front. Not to say I haven't taped some remarkable things. Just the other week I settled in front of my video to watch a tape of the ABC series *Blackeyes* . . . the one that's supposed to be a bit racy . . . and what came on? The Wombles . . . Uncle Orinko cavorting with a hedgehog on Wimbledon Common. I have the instruction manual. It says: "So simple even a child can use it."

It was not specified that a Japanese child with a nodding acquaintance of quantum mechanics was the person the manual writer had in mind. This manual writer, you will have grasped, is descended from the lever and pulley technocrats of Ancient Egypt.

TODD DAVIDSON

A quote from the hieroglyphics from the manual: "For programming the timer to record from an external source, while the channel position is blinking, press SET + MINUS until the AU indicator appears in the channel display section." I followed these inscrutable instructions and seem to have ended up with the Tokyo to Kyoto train timetable.

I also have a Japanese stereo which says "Hello" and "Goodbye." I know this is in an attempt to make my technology user-friendly. I may point out here that no farmer ever wanted to have a conversation with his plow: the horse perhaps, but even then he didn't expect it to talk back.

If the stereo must talk, why doesn't it say something useful? Why doesn't it tell the video to stop stuffing about and record what it's supposed to?

As I was remonstrating with the video and stereo, my portable phone rang. The phone in the easy-to-use, easy-to-lose size which rings at the exact pitch which sets my car keys off. So I was running around the house looking for the phone with the car keys screaming at me and I grabbed what I thought was the unit only to realise I was talking to the TV remote control. Realising my mistake, I was just about to hang up when Uncle Orinoko came on the line wanting to know whether he was "out of line with the hedgehog gag."

By the time I had advised him and found the phone, the answering machine had taken the call and told the caller that I wasn't in right now, but would they like to speak to the stereo? This was incredibly annoying because the stereo had gone out on a hot date with the car keys.

Later in the evening I returned home to find the stereo and the keys had ganged up and changed the locks on my house. I climbed through the back window only to find a wild party in progress . . . the dimmer switch was going up and down; the central heating was on full bore; the microwave was whirling round and round and there . . . on my couch . . . were the remotes from the CD and the TV, the portable telephone, the answering machine and stereo all eating takeaway Japanese and watching reruns of the dirty bits out of the Wombles.

I should have been angry, but I realised that I had finally achieved something I had been secretly striving for . . . a lifestyle which no longer required my presence. I knew I was time to return to my roots. Back to the basic world of rock and stick. With a jug of wine, a lump of bread and some cheese and sat under a tree in the backyard to savour these simple pleasures . . . and do you know I sat there for three bloody hours and couldn't work the cheese?

HINDSIGHT

A regular section looking at past predictions of the future

The first woman to stand as a parliamentary candidate in Australia, Catherine Helen Spence (1825-1910), migrated with her family from Scotland to South Australia in 1839. In her novel, A Week in the Future, written in 1888-89, she speculated about life a century on:

Marriage: The young people gave themselves to each other. It was evidently looked upon as their own affair; they did not actually promise and vow to love, honour and cherish each other, but only to try to do these things; the vow of obedience was left out.

Divorce: So long as there were no children born of a marriage, divorce was easily obtained. A declaration by both parties that they sought release, repeated after three months given for reconsideration, was sufficient. After children were born, matters became more serious and difficult, this required three declarations, extending over 12 months.

Education: I found the nation paid all the cost of primary education out of national revenues. It also supported the universities, but I was surprised to find that the continuation schools, the link between the public schools and the university, were attended mostly by people engaged in bread-winning occupations, and taught by others similarly engaged.

Childcare: In the nursery stood a baby prison-house. It was a good sized circular basket, weighted so that it could not be overturned, and softly lined and cushioned. A baby creeps to some forbidden place, inconvenient to others and dangerous to himself. He is gently removed. He creeps there again and again. The nurse lifts him quietly and gently, places him in the basket and gives him toys. There he remains till the impulse to disobey has worn itself out; the attraction has been forgotten. These children are trained to docility and prompt obedience, and understand perfectly the simple principle that if they abuse liberty, their liberty will be abridged. They are sensitive in a high degree to affection, for love has surrounded them, and from the very dawn of consciousness formed the one stimulus to painful effort, and to successful effort the natural and abundant reward.

Gambling: When society was reconstructed, bookmakers and other vermin who preyed on the weaknesses and the credulity of society were dealt with as rogues and vagabonds. Many of them were driven into industrial life, many, indeed, had talents which, rightly directed, were useful.

Vegetarianism: The food was abundant and excellently cooked and served, but there was far less meat on the table than I was accustomed to see. Three of the families were absolutely vegetarians, but independent of that, vegetable diet took a much greater place in the food of the people now that all classes lived alike.

Sports: The old games of cricket and football and tennis still exist with some modifications, and a dozen new games of skill and speed have been invented for boys and girls, sometimes separated, sometimes mixed.

War: "I suppose war was put an end to because the burden of taxation was no longer endurable."

"Partly so; but quite as much because engines were devised and constructed so destructive that human nature recoiled from them in horror."

Transport: Horses were costly luxuries which few could afford, but cycling was the favourite exercise of the young and a very useful means of locomotion for all ages. The street traffic, ofcourse, was enormously reduced, for London only contained as many inhabitants as it did at the beginning of this century – about a million – and to this number I learned, to my satisfaction, that Paris and New York had also been brought.

Crime: The criminal statistics of the country were eminently satisfactory. Offences against the person were even rarer than those against the property and these – owing to the industrial education of the people, and the openings for earning an honest livelihood, were wonderfully few.

Working hours: "What are the hours in America and Australia?"
"Six hours, but I believe the style of living is more luxurious than here."

DISCRETION
Mistress: Jessie, did Mr James ask if I was in?
Maid: No, mum. He asked if master was out.

Russia: "And Russia," said I eagerly, "Has Russia obtained freedom?"

"Oh yes, long ago. It is strange to look back a hundred years. Russia is still backward as compared to England, but there was a marvellous moment after the fall of the Autocracy. You had the French Revolution as your type of terrible catastrophe: that was nothing to the Russian Revolution. "

*Extracts from **A Week in the Future** by Catherine Helen Spence, reprinted in 1988 by Hale & Ironmonger.*

Where design meets ecology

Major international and Australian figures will meet in October to tackle issues surrounding a transition towards ecologically sustainable development. The conference, entitled EcoDesign (sustainability through design), is a joint initiative of the Centre for Design at the Royal Melbourne Institute of Technology and the Commission for the Future. The conference will be the first time in Australia that designers, educators, industry, environmentalists and policy makers will meet to explore the role of design in resolving environmental problems and creating a sustainable economic future.

Key figures invited to speak and participate include Ezio Manzini, director of design at the Domus Academy (Milan), Arno Eisenhoffer, director of BMW's design for disassembly and recycling plant (Bavaria) and tony Fry, the director of the Eco-Design Foundation (Aust.). The speakers will be involved in active workshops and other conference activities.

The conference takes as its premise that centuries of development without substantial attention to social and environmental impact have led to an urgent need for designers to take a central role in raising levels of environmental awareness and performance. The EcoDesign conference will range in subject matter from the built and urban environment through to manufactured products. The intention is to present the need to develop an environmental consciousness at the start of any process that has the potential to affect the environment. "This would remove the need to deal with environmental impacts through a process which is ameliorative rather than one which is positively benign form the outset," say the organisers.

Clean coal: Australian research lead

In the popular mind the word "coal" has become so associated with grime and dirt that scientists and technologists working with this highly valuable resource have felt constrained to coin terms for new products like "clean coal," "superclean coal" and "ultraclean coal" which will help to counteract coal's old image.

CSIRO's new process for producing ultraclean coal has secured Australian patents and patents have been applied for in 19 other countries.

"I believe we have the leading product in the world. But, a lack of marketing opportunities may hold us back in a well-established industry like coal where change does not occur quickly," said Dr Peter Alfredson, chief of the Division of Coal and Energy Technology.

To obtain ultraclean coal, which has an ash content of less than one per cent, coal is treated chemically with steam, caustic soda and sulphuric acid. The process roughly doubles the value of coal from $40-50 to $80-100 per tonne.

Expenditure on the pilot plant established at the Ulan coal mine near Mudgee is $3 million to date.

There are several applications for superclean and ultraclean coal. The product suitable for a particular use can be selected from a range of "cleanliness" and prices:

- As a coal/water mix to replace fuel oils still used in many power stations in Japan and elsewhere.
- As an alternative to oil for feedstock to chemical plants.
- As a cleaner fuel for some power stations and industrial installations.
- As a feedstock for special carbon products such as "anode coke" for aluminium smelters (in place of petroleum-originated coke which costs Australia $70 m annually in imports).
- For direct firing in pulverised form into turbines in advanced power generation systems.

CSIRO has also recently commissioned a pilot plant at North Ryde for testing methods of producing the next grade of coal, superclean, which has an ash content of 1-5 per cent and costs up to $60 per tonne.

Dr Alfredson said the plant has only just come on stream and it is too early for significant results to have emerged.

A techno toehold at a price

BY KATE HALFPENNY

Under the bed you probably have something with more technology behind it than a space shuttle. A pair of running shoes. What once looked like a slipper on a rubber slab now comes complete with everything from lateral support systems to stitched partial forefeet and reflective trim for night visibility.

Since the midsole – a thick pad under the instep – was first marketed in 1968, shoes have become a sort of deluxe hamburger with the lot, loaded with features that were once revolutionary and are now standard. But the issue has gone past soft cell cushioning, reinforced outsides to enhance natural running motion and lace locks for customised fit. The question now is: has fierce competition between manufacturers led to more and more gimmicks being loaded onto our feet at higher and higher prices, with no real gains?

And the answer is: maybe, if it suits the consumer. Sportswear companies are increasingly moving with the global trend towards streamlining and protecting resources, and in the last four or five years have cut down on fancy geegaws (like computerised dials that tell a wearer how far he or she has run and at what pace); the smart athlete doesn't want to be seen in shoes that scream waste and extravagance.

"In terms of the future, adidas have recognised that products in the sporting goods market have been driven by advertising gimmicks, gushy effects and short-lived ideas," said the company's product manager (footwear), Malcolm Owen. "The future lies in a range in which form follows function, where everything is essential and nothing is not."

The marketing campaigns espouse the benefits of "honesty" in shoes; what you get is very advanced footwear wrapped in homespun values. What you get may also be out of date at the time of its release compared to what is on the drawing board at sports research laboratories throughout the world. But lips are sealed. No company will even hypothesise on the technology of its next range, let alone what the next 10 years will produce.

"There is something that becomes commercially available but you know there is something on the drawing board that will overshadow it. It happens quite regularly," said Nike's national sales manager David Munro.

So what lies ahead for running shoes? As we said, mum is the word from manufacturers, but it is reasonable to assume the major design weapons of big companies – the three in competition for the number one brand position worldwide are adidas, Nike and Reebok – will be around for a few more years yet. They tend to each have a trademark they build around.

The not-so-secret ingredient that powers adidas's new direction is Torsion technology, which has taken a decade of research by biomechanical and orthopaedic experts to develop. It operates on the theory that separating the forefoot and heel enables the foot to rotate in the same way as if running barefoot. According to adidas, it increases natural energy tranfer from the lower leg and knee up to the hip, and protects the foot from unnecessary exertion and injury.

'Has fierce competition led to more gimmicks being loaded onto our feet at higher prices?'

The system is based on two inter-related features – a torsion groove or incision in the sole, and a torsion bar to prevent extreme and unnatural rotating of the foot. The flexing of the sole is limited to a biomechanically controlled degree.

Nike has been banking on its "greatest innovation to date" since 1977, ages ago in terms of shoe technology. Nike-Air is a urethane bag filled with a special permanently-pressurised gas which is placed in the midsole. Because of its molecular structure, the gas can't escape but is compressed and immediately returns to its original shape.

One of the newest Nike shoes, released in Australia in July, is the Air 180, which has an Air-Sole 50 per cent larger than in any other shoe the company has made and is therefore said to give more protection from impact shock. Another new Nike shoe has no solid heel counter – the bit at the back of the shoe which your heel rests against – but a stretchy sleeve and a moulded rubber strap to hold the foot in place. Object: a shoe that feels as light as meringue and holds you firmly in place.

"We try to make something that is as close to the natural foot as possible, but still provides stability and protection. I don't know if that will ever be achieved, and it's a long, long way off at least. There's still so much to be done. Everything that affects the end product – what becomes available in manufacturing processes and materials – is changing and advancing," said David Munro.

The thought for the day to mull over as you pound through your regular 10 km run: Zola Budd ran barefoot in international competitions, and Liz Smylie won the Wimbledon mixed doubles this year wearing Dunlop Volleys – no midsole, no clever supports and a recommended retail price of $19.95.

NEXT IN AMERICA

➢ Lung cancer has surpassed breast cancer as a primary killer of women, according to Professor John R. Benfield, who is chief of cardiothoracic surgery at the University of California medical centre. Since 1987, mortality from lung cancer has outdistanced that from breast cancer among women, and the trend continues because of the increased number of women who smoke. Symptoms usually do not appear until the disease is advanced.

Source:THE FUTURIST

➢ Hundreds of men who took trazodone for depression in the 1980s suffered unexpected or unusually painful and prolonged erections. Lawsuits were brought against the manufacturer, Bristol-Meyers. Now efforts are being made to put the experience to benefit the million mildly impotent men affected by injury or atherosclerosis. These men take longer to achieve erections, a problem compounded by their frustration, which triggers nerve signals to drain the penis. A urologist at Boston University school of medicine, Irwin Goldstein, says: "A safe form of trazodone would prevent patients from turning themselves off." He is seeking funding.

Source: DISCOVER

➢ The ultimate in user-friendly computers – systems that recognise human speech so that people can talk directly to them – are beginning to move out of the lab. According to a New York securities trader who spends most of the day chatting to his computer, it is not only faster than typing but also less error-prone. The US market for speech-recognition hardware and software will surpass $100 million this year, but the holy grail is a system that will allow people to treat their PC like a human secretary, verbally telling it to take dictation then print documents. The drawback: large-vocabularly systems must be trained to recognise the nuances of each speaker's voice.

Source: BUSINESS WEEK

➢ Allergy and asthma sufferers know all too well that their carpets don't make them feel snug as a bug in a rug. A recent study in Japan concluded that all varieties of carpeting play host to dirt, dust, germs, mold, pollen and parasites. Their effects on people with respiratory ailments are aggravated by "sick building syndrome" – the inability of energy-efficient buildings to adequately recirculate indoor air. The US National Wood Flooring Association believes that uncarpeted hardwood floors offer the best answer for those who cannot tolerate allergenic substances.

Source: THE FUTURIST

➢ Depressed adolescents may become depressed adults, according to Professor Peter Lewinsohn, a psychologist from the University of Oregon. He told a gathering at the Australian behaviour modification conference at the University of Sydney: "Based on our study of 1700 kids, the prevalence of depression among 14-18 year olds is surprisingly high at 3 per cent. This is the same figure for the adult population. We expected there to be a big increase in depression between the ages of 15 and 18, but we found that the levels of depression among 15 year olds was as high as 18 year olds. As is the case with adults, depression is much more prevalent among girls, with twice as many girlds being depressed as boys."
Most depressed children tended to be quiet and did not seek help, he said. Problems needed to be identified as soon as possible. "We have done a treatment outcome study with 200 kids, treatring them like students and treaching them the skills to cope with depression. Two years afterewards, 80 per cent were still well. Adults given the same treatment show a 50 per cent relapse rate after only one year."

Source: UNIVERSITY OF SYDNEY

➢ Engineers have developed a simple silicon chip that could permit more car makers to install air bags for passengers as well as the driver. Because designers must plan for the worst case, a flat battery means triggering an air bag could use up all the remaining vovltage. But the new device, called a semiconductor bridge, requires much less energy than a hot wire and can be heated much faster, with less energy. And because it is based on a silicon wafer, it can incorporate circuitry for logic, timing and safety. It can be controlled and monitored by a car's computer system. Sandia National Laboratories is seeking customers.

Source: NEW YORK TIMES

➢ The American Chemical Society warns scientists against recording lab notes on computers rather than in notebooks. Computer records are so easy to change they might not serve as evidence in patent disputes, the group says.

Lessons for today

As a senior citizen – oh dreaded title – I still enjoy filling the holes left by my youthful inclinations. Back in my student days, I was more interested in subjects outside my faculty of economics, so I began studying elementary Russian.

Later, as a graduate in social studies and expecting my first child, I took to classes at evening college or tech and after that joined discussion groups. Pottery, art, literature, music appreciation: there were so many subjects.

In those days there was absolutely no childcare as we know it, so women were dependent on family support to get out. Home-based discussion groups were perfect. Now, of course, there is more than one university in every state and we have innumerable TAFE colleges, community centres and other organisations providing programs.

What was I seeking? Knowledge, skills and perhaps with them a little power. At any rate, I was a hungry consumer. Now I seem to have become a partial provider. Quite frankly, any vision of a future in which one can only play a short-term part is to me rather depressing and disappointing.

Not that one fears it, but one does resent the prospect of not being involved. I'd like to see and hear and be part of my grandchildren's exciting lives beyond 2000. Right now, there are so many things to be done that there is not going to be an idle moment.

Idleness. Now that could be a problem for young and old. Yet many of my friends are in their eighties and still leading extremely active, useful and productive lives. Several are studying Italian language and culture, others French, and one clever woman sews fine furnishings to augment her income and utilise her skills. She is 88.

MARGARET WHITLAM

Getting on with the rest of my life in a positive and progressive way has become a bit of a fixation. I am daunted because so many contributors to this magazine are full of erudition or youthful fire. Yet lack of opportunity can be a handicap for many. There are one million Australians whose basic literacy skills do not fit them for life in this century, let alone the next. It is an astonishing and troubling statistic.

These people missed out in youth because of ill-health, distance from schools, uncaring parents, disinterest, or because they came from migrant families. There was no single reason, nor is there a single solution. This has been made very clear to me during the past two years on the national advisory council for International Literacy Year.

You will be wondering why an international year actually takes two. Apart from the necessity to plan ahead and to wind down afterwards, we hope it goes on in spirit for 10 years or 20, until the goal of Education For All is reached. Australia is among the so-called developed countries, advanced and industrialised, yet there is no guarantee we shall all eventually be able to read and write.

As school-leaver intakes decline and the demand for the skilling and reskilling of the workforce increases, the adult learner is rapidly becoming the new majority. Professor Richard Johnson set out the way of the future recently in an address to the conference of the Australian Association of Adult and Community Education. "Within the next 10 years," he said," there is very likely to be a backlash against an almost exclusive concentration on economic values and outcomes. Humans are spiritual beings. We do value quality of life and personal growth and emotional and intellectual development.

"Economic security is a necessity but it is not good in itself; it is good because it enables other things to happen, and I suspect there will be renewed requests for those 'other things' – the things which have been the traditional concerns of adult educators. At the same time, for too long adult educators have suffered from the image that they are people dressed in homespun, living on organically-grown lentils and engaged in basket weaving. This is an image we need to correct, not reinforce ... we should place careful attention on the quality of what we offer and what we do ... shoddy performance will lead to shoddy treatment ... the task before us is to take control of our future: to gather data, to determine objectives, to plan and co-ordinate steps towards those objectives."

It has been said that in training adults and/or continuing their education, you are taking away the chances of young people and keeping them from promotion or placement. Not so. Adult education provides something extra for all, from the young who missed out on the very basics to those who want an extension of their qualifications for advancement, or preparation for what is called retirement.

As Professor Johnson pointed out, the 1960s saw the beginning of a great expansion of enrolment in higher education. "It is a well-known phenomenon that the more education one has received the more likely it is that one will seek non-formal adult education. Therefore one factor in adult education's growth and rise in status most certainly is simply the large number of more highly-educated people: there are now some one million higher education graduates in the community."

Perhaps I should point out again that there are also more than one million functionally illiterate adults in Australia. Learning is a lifelong process and important for the whole community. Australia can benefit economically, culturally and socially if the process is wide, and equitable. I think AdEd is good for the nation. I know it has been good for me.

Margaret Whitlam, a professional social worker, is president of the Commonwealth Association for the Education and Training of Adults

Future is Apples for IBM

Rivals IBM and Apple have agreed to join forces to bring standardised, user-friendly software and hardware to the ever-burgeoning and competitive personal computer market.

The planned alliance, announced in early July and variously described as electrifying and startling – one pundit called it the deal of the decade – now has commentators and PC industry specialists discussing it as a logical and obvious high-tech matchup, almost as though they had dreamed it up themselves.

It was "less an anomaly than a natural and salutary culmination of several recent trends in the personal computer business, including standardisation of PCs," wrote *Washington Post* technology columnist Curt Suplee.

The deal acknowledged the consumer push for personal computing shaped by software design, not name-brand hardware sales. It illuminated the need for industry-wide standards and so-called open systems after a decade of "rampaging technological progress and proliferating incompatibilities," he wrote.

In fact, it was a deal of the decade in "much the same way that the Madonna and Sean Penn nuptials were the marriage of the decade: big names, lots of personality, but not necessarily a relationship destined to change the world," was the more cynical view of Michael Schrage of the *Los Angeles Times*.

As the pragmatists saw it, it was a case of another big company (that is, the behemoth IBM) forced into technological alliances to help it regain its leadership role. After all, both International Business Machines Corp and Apple Computer Inc. have been menaced by the success of competitors' software programs (such as Microsoft's Windows 3.0 operating environment) and a flurry of cheap IBM hardware clones at a time when their market share was on the way down.

For instance, in 1985 IBM sold 27 percent of all PCs purchased and Apple had more than 15 percent. By 1990, both companies combined accounted for less than 30 percent of the market.

As such, IBM has been hunting for nuggets of technology to bolster its fortunes in the market it entered in 1981 with the introduction of its personal computer.

Perhaps it is not such an unlikely or unholy alliance, given IBM's recent propensity for courting and both companies' needs to shore up against a brace of rivals. Not that Apple is the first rival on which IBM has danced attendance and eventually toyed with marriage, albeit of convenience. Already, IBM has developed relationships worth at least US$500 million in more than three dozen partnerships, including those with Siemens (memory chips), Wang Laboratories (imaging), Toshiba (flat panel displays) and Go Corporation (pen-based computer operating systems).

It's a marriage between big names, just like Madonna's nuptials

And only days after the Apple deal was announced, IBM agreed to buy for an estimated US$100 million the Metaphor Computer Systems Inc, a software firm whose expertise is expected to play a large role in the IBM-Apple alliance.

Metaphor, which last year formed a joint venture with IBM called Patriot Partners, will now operate as a wholly-owned subsidiary of IBM. It is being called on to develop a new operating system based on "object-oriented" software, which is expected to be as user-friendly for software programmers as that belonging to the original Apple Macintosh.

Already, both IBM and Apple have endorsed object-oriented technology in a wide-ranging agreement that, among other things, calls for its development under the auspices of an independent, jointly-owned company, details of which will be announced when the two companies sign.

In a bid to compete with the likes of software market leader Microsoft Corp and chip-maker Intel Corp, both IBM and Apple have also agreed to co-develop some other products, and may even sell some of each other's wares. Apple will also use an IBM-designed chip in future models of its Macintosh computer.

Optimistic commentators suggest the need for a strong US computer industry augurs well for a strong alliance between Apple and IBM, once they have gained government antitrust clearance.

"This is a kind of embryonic American version of an industrial group," said Joseph L. Badaracco Jr., a lecturer at Harvard Business School and the author of a recent book comparing alliance strategies at IBM and General Motors Corp. "It is an important test case," he said.

While Mr Badaracco says "the jury is still out" on whether IBM can rebuild its market and technological dominance, a range of partnerships, a new pricing strategy and a strong showing at a recent industry computer show indicates that IBM may yet stall Microsoft's momentum.

CHRISTOBEL BOTTEN

TRIPLE J DID NOT DISCOVER ABBA.

We also can claim no responsibility for Kylie Minogue's success. Or Julio Iglesias's. But pretty well every other major new act in the last 16 years, from INXS and Midnight Oil through to Ratcat, got its start in this country with us.

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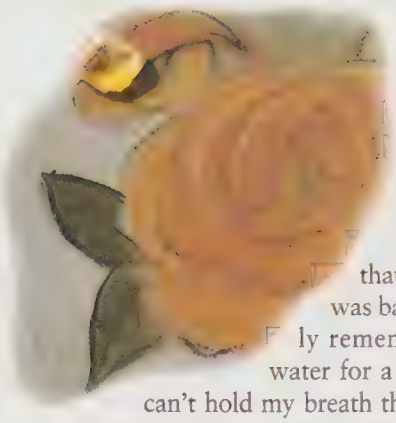
Dream life

BY ROS LAWSON

We all dream. But why we dream and what those dreams mean remains a mystery to most. Now lucid dreaming, where sleepers have 'waking dreams' and remember more, unlocks the door to dramatic breakthroughs in research



"I HAD A wonderful adventure dream where I was an undersea pirate. I woke up and thought 'That was just great. I'd like to go back to that dream'. And the next night I was back in that dream and I distinctly remember noticing I'd been under water for a very long time and thinking, 'I can't hold my breath this long but, oh, never mind, it's just that in these dreams I can. I don't have to breathe or I can breathe water or something.'"

That was the dream of a five-year-old American, Stephen LaBerge. Years later, that undersea pirate got his doctorate for researching into such dreams. Today he continues research in the psychology department at California's Stanford University. The "treasure" for this pirate is prising open the secrets of the dream world using the technique of lucid dreaming. What's unusual about that undersea dream is that he was aware during the dream that it was a dream. And that he could "direct" the action.

Lucid dream research has had a rocky road to scientific respectability. Whether such dreams are a suitable case for scientific study has been disputed for most of this century. They have largely been associated with the fringe areas of the paranormal and the occult. Most scientists argued that they could not be real dreams at all, that the very idea of being aware in a dream was a contradiction in terms. Such a "dream" must be occurring in brief moments of wakefulness or in the transition between waking and sleeping. They couldn't possible occur during the sleep of ordinary dreams.

The sleeping brain is involved in a sort of continuous battle for possession of the mind

Freud started science on the path to unlocking the secrets of the dream world in 1900 with publication of *The Interpretation of Dreams*. Nearly 100 years later we understand dreaming as part of a biologically determined sleep cycle. Each night, our sleep is punctuated by periods when recordings of the electrical activity of the brain show brain waves similar to those observed when we are awake. These are unlike anything usually seen in sleep.

As we drift off, brain waves slow in frequency and grow in amplitude. But every 90 minutes or so, the brain waves become irregular in frequency and low in amplitude. At the same time, the eyes are flickering under closed lids, giving rise to the term REM (rapid eye movement) sleep. Wake someone during REM sleep and they will report vivid, elaborate dreams. And they will recall as much as 90 per cent of those dreams. Those of us who say "Oh, I hardly ever dream", are really saying we hardly ever remember our dreams. We dream as much as two hours a night, but would be lucky to remember a small segment.

One dream we can all remember is the utter terror of being chased by a monster, or where we are in some situation of great danger, and unable to move. Freudians would say it is because there's a conflict between the desire to move and a deep subconscious wish preventing it, but physiologists have a much more mundane explanation.

We now know that the dreamer literally cannot move. In REM sleep, you are virtually paralysed from the neck down. Motor neurons are inhibited, preventing the body from moving freely, but allowing the extremities to remain slightly active. Most reflexes are suppressed, and about the only thing that can move is those twitching eyes. People who report waking up shouting or screaming from a nightmare have already come out of REM and, in a few seconds, regained control of their muscles. Sleep-walking and sleep-talking take place in non-REM sleep. Most researchers say that while it is possible to dream in non-REM sleep, these dreams are less detailed and briefer than ordinary dreams, and rarely remembered.

But do lucid dreams take place in REM sleep like normal dreams? The biggest hurdle has been getting lucid dreamers to somehow communicate to researchers the point at which they are aware they're dreaming.They can hardly wake up because that would end REM sleep and, being almost paralysed, they can hardly shout "Hey! Listen to me, I'm dreaming". The breakthrough came last decade when English researchers at the University of Hull realised that sleep subjects could use the eye movement in REM to signal to researchers when they were in REM and lucidly dreaming.

With this knowledge, LaBerge had a way of getting signals from deep within the dream state. Next came the subjects, wired with electrodes attached to scalp and face to monitor brain waves and eye muscle movements. Before they were allowed to drift off in the spartan, black-walled, sound-proofed cubicle, LaBerge told them to perform a sequence of eye movements to signal the onset of lucidity. For example, three eye movements to the left, followed by three to the right. The monitors pick up this sequence because the eye movement display is quite distinct, being larger and more rhythmic than ordinary eye movement. At the same time, the all important brain wave readouts are showing the characteristic waves of REM sleep.

Apart from its novelty value, can lucid dreams throw light (as well as heat) into the debate on what our dreams are all about? LaBerge claims such lucidity can be used to understand what is happening in ordinary dreams. No longer does the dreamer have to be woken up to report on dream activity, and because the researchers can tell by the polygraph readouts when lucid dreaming started, they can see how long a reported action actually took. If dreamers say they were giving a speech, singing or even having a rather nice sexual encounter, the brain wave patterns, changes in heart and respiration rates show that the body is indeed reacting as if doing these things.

And in real time, at the same rate as if they were awake. In one simple study, LaBerge got his subjects to count to 10 when awake, then got them to count to 10 after they had signalled that they had begun lucidly dreaming. So there seems to be a close correspondence between actions of the body in dreams and, if not real movements, at least the electrical responses. Lucid dreaming actions are somewhere between real actions when muscles work to move the body and waking imagery when such muscles are not involved at all. That at least clears up the debate about how long a dream event actually takes. The boy who wondered whether dream undersea pirates actually held their breath, now knows that indeed they do.

The catch to lucid dreaming is that it is not something the average person can easily manage. LaBerge himself admits that lucid dreamers tend to be good at self-hypnosis and are strongly motivated, with high capacities of concentration. Some people may already be lucidly dreaming without realising it. Athletes, dancers, and anyone who mentally rehearses their performance before an actual event is probably doing it already. And while LaBerge claims there is no evidence that persistent lucid dreamers suffer any physical effects from doing something out of the ordinary, it's

well known that interfering with REM sleep can have serious effects. Dr Harry Fiss, from the University of Connecticut's Health Centre, says depriving people of their REM makes them stressed and anxious and unable to learn as well the next day.

Lucid dreaming's most immediate value lies in giving researchers a new tool for looking at those ordinary dreams – the dreams we must have, the dreams we cannot chose NOT to have. In classic REM deprivation studies from the '60s, subjects awoken when they began their first or second periods of eye movements would make up for the lost REM either in REM periods later in the night, or the next day. REM-deprived people who rarely day-dreamed suddenly found themselves having waking fantasies.The brain just had to do double duty when REM was interrupted. The process is called REM rebound. In his landmark study, Dr Fiss studied alcoholics who are REM-deprived because of their drinking. Like many drugs, alcohol suppresses REM sleep. Bringing them into his laboratory, Dr Fiss found the alcoholics made up for these deprivations by having more than normal amounts of REM sleep, and consequently, more dreams. Upon waking naturally in the morning these subjects were able to recall as much as 90 per cent of their dreams, an extraordinary amount. Most of us can usually only manage a few per cent when we wake up.

So much for when we dream, what of the content of those dreams? What can modern physiology tell us about the effects of bodily processes on what we dream? As we sleep and dream we are not conscious of the world around us, but our brains continue to monitor the environment through the senses. We may be virtually paralysed in REM but we are not entirely vulnerable. Many of us have awoken suddenly to a strange sound, perhaps on the premise that it's an intruder. Because of this continuous monitoring, occasional pieces of action get incorporated into our dream content. In one classic study, a hapless volunteer was sprayed with water while in REM sleep. On waking, he described a dream in which he was acting in a play, following the leading lady who suddenly collapsed with water dripping on her. When he ran over to her, water began dripping on his own back and head. He thought to himself that the roof was leaking. Dr Fiss proposes that as dreams can detect detect faint signals from without, they may also one day be able to detect such signals from within.

By monitoring our dream content, we might be able to pick up some disease signals before they even emerge full blast as symptoms. Dreams as a sort of internal early warning system. His ideas follow work done in the '80s by Professor Bob Smith, from the University of Michigan's Internal Medicine Department. He found he could predict the severity of cardiac illness from the dream content of patients six weeks before that severity had been tested. He studied 50 men and women who were suspected of heart problems and were due to have tests to confirm them. He asked them to report on the content of their recent dreams. The men reported dreams featuring death and destruction, such as: "I was walking down the street and drove past a graveyard . . . I dreamt my mother had died". Women had dreams featuring separation, such as: "I miss my mother. She lives in California", and "I miss my children. They're at school". When tested for their ejection fraction (the amount of blood the heart pumps out) those with the above dream content ejected a significantly lower amount of blood. Their dreams were telling them just how sick they were.

Dreams are not about smells and sounds, they are about images, because that's all the brain has to work with. Dr Fiss claims it is easy to explain why dream content can often seem so bizarre and extraordinary. Dreams are a form of thinking which expresses itself in concrete images. But these images are symbolic and have to be translated into everyday language. The waking brain, with its capacity for rational abstract thought, is not operational, so the dream images seem disconnected and unrelated. It's little wonder dream thoughts do not obey the waking rules.

Dream content may indeed be symbolic, but few scientists today would interpret them in a convoluted and complicated way. Dr Fiss says that if a person dreams that someone drops dead, it could merely be that the thought has dropped dead. Or if a patient thinks their therapist is somewhat stupid and something of an ass, he dreams of the therapist with long ears. According to Dr Fiss, scientists who cling to the bizarre nature of dreams do so to bolster their theories that dreaming is merely a biological function, in the most extreme of cases, a random firing of brain cells deprived of outside stimulae. Harvard neurologist and psychiatrist Allan Hobson is well known for this point of view, and for arguing that the psychoanalytic theory of dreams is a museum piece. In the early '70s he made a momentous discovery while looking for cells that fired only in REM sleep. Instead he found a cell that stopped firing in REM. Thus was born the idea that the brainstem contains clusters of cells that trigger REM sleep and other clusters that turn REM sleep off.

Smith found he could predict the severity of cardiac illness from the dream content of patients

Dreaming depends on which cells have the upper hand. The sleeping brain is involved in a sort of continuous battle for possession of the mind. Hobson said that dreams are caused by spontaneous electrochemical signals in the brain, and that they are inherently meaningless. That, of course, raises the issue of how dreams can be creative and often solve problems. How can the catchcry of "It came to me in a dream" exist if dreams are merely random firings of brain cells? Such a process couldn't possibly have given Robert Louis Stevenson the plot for *The Strange Case of Dr Jekyll and Mr Hyde* and

the inventor of the sewing machine needle, Elias Howe, after unsuccessfully trying to put the eye in the middle of the shaft, one night dreamt of being attacked by natives bearing spears with holes near the tip of the shaft.

Researchers now focus on how dream content relates to everyday events. Dr John Davidson from the University of Tasmania has tried to identify the relationship between dream content and recent life events to establish that dreams have a basis in the mind rather than just biology. His evidence shows that dreams are primarily influenced by current life experiences.

Taking a control group of mothers with preschool children, he compared their dream content with mothers who had just given birth. With the preschool mothers, there was no dream content featuring birth and hospitals, whereas with the first time mothers more than 30 per cent of their dreams had such content. With mothers who had just given birth for the second or third time, the dream content of birth and hospitals was only 20 per cent. We dream about things that are important to us, not about images the brain throws up at random.

The biggest hurdle has been getting lucid dreamers to somehow communicate

Dr Davidson's team is one of the few in Australia actively researching dreams, and they are very keen to reverse what seems like the ascendancy of the biologists. We know what substances brain cells emit as they dream, what electrical activity is going on, but when the picture widens to look at how the dreaming brain functions in part andas a whole, that pictureis very fuzzy indeed. Dr Davidson says that trying to understand dreams only in terms of physiological processes is like trying to predict what two people are going to say in a conversation. In both people, the physiolocal processes are the same, the brain cells are firing in the same way, muscles are working in the same manner, but what is going to be said is a unique combination of the individual's logical and psychological processes.

Modern psychology has been working to establish that there are different types of dreams, but these are based on different physiological processes. Dr Davidson's team is just about to release their research into this very theory, which is an extension of Allan Hobson's premise that dreams are the result of biology, of randomly-fired neurons deprived of outside stimulae. Hobson's theory has led other researchers to speculate that vivid and bizarre images are created solely by those random firings. More mundane images are supposedly generated by the brain trying to fit them into a narrative structure, and the brain using psychological processes.

Dr Davidson collected a series of dreams from subjects in his sleep laboratory, then asked them to chose vivid and vague images from the same dream. Independent assessors were given the images and the plots they came from, and were asked to rate their bizarreness or vividness. What was surprising was that the subjects' chosen vivid images were not rated as such by the assessors. The images did not seem at all bizarre to the independent observers when they saw them in the context of the plots. Dr Davidson says that because the vivid images did not stand out, the same psychological processes were involved in producing both vague and vivid images. There are not different types of dreams based on different biological processes.

Such findings would no doubt be music to the ears of scientists like Dr Harry Fiss, who says very few advances have been made in understanding dreams since the early '70s because of the ascendancy of the biologists. "We are in the age of biology, where science is forgetting that dreaming is an experience not a chemical process. How can brains dream? People dream, not brains. The only way to understand dreams is to ask people who have them. We know a lot about the biology of dreaming without knowing what dreaming is the biology of."

So how far has science come down the track of understanding why we dream? We certainly know a lot about the content of those dreams. While today's dream interpreters do not follow an explicit party line, they do share some common beliefs. Most would agree that dreams are triggered by emotional concerns, they are not the result of repressed wishes alone, they don't have to do with sex, and they use symbols as metaphors to convey meaning rather than as disguises to obscure it. Even Hobson cannot bring himself to completely jettison Freud's psychological approach.

In his most recent book, Hobson says he wants to retain psychoanalysis' emphasis on the power of dreams to reveal deep aspects of ourselves, but without recourse to the concepts of disguise and censorship or symbols. "The dreaming brain seeks to create order out of chaos, and that order is a function of our personal view of the world, current preoccupations, feelings, remote memories and beliefs. Dreams are now out in the daylight as healthy, necessary to our function as normal people."

The emphasis has moved away from just a psychoanalytic approach to understanding dreaming. Psychoanalysis has been on the decline since the '60s because of the ascendancy of scientists like Hobson, seeking to explain dreams in terms of biology. Spurred on by brain diseases like depression and schizophrenia yielding their biochemical secrets, and lured by the promise of creating chemical cocktails to alleviate their symptoms, it must be frustrating for scientists to admit that they are no closer to understanding why we dream. Nearly 100 years have gone by since dreams were first rescued from oblivion as the stuff of fortune tellers and made into a subject worthy of scientific study. Now LaBerge claims that in the next decade we will learn more about dreams than we have in the previous 100 years, but as we enter the 21st century our knowledge about the dreaming brain will still be minute compared to what is actually there.

Ros Lawson is a producer on ABC TV's Quantum.

Pillow talk

Melbourne Psychotherapist Peter O'Connor interprets the dreams of three well-known Australians.

JUSTICE MICHAEL KIRBY

President of the NSW Court of Appeals

I dreamt I was a judge in the Supreme Court in Hong Kong. They are in a difficult situation because of the coming takeover by China, and I was there, in what seemed to me to be a claustrophobic environment. There were a lot of people together in a very small area, with huge buildings, and it was very loud and crowded and commercial, and I felt like I was in an alien world. Visually not much happened, but it was very vivid emotionally, and I felt very upset. I woke up in a cold sweat, thinking I had to deal with China taking over.

In relation to these two places the dreamer is seen as fulfilling a position of ultimate rationality and objectivity in his role as a judge. We have no indication of what China and Hong Kong mean to this dreamer personally, but one might regard China as the very unsophisticated and undifferentiated aspects of the dreamer threatening to take over his more rational and highly developed self. Such a theme is common in mens' dreams, and at certain points in a man's life it demands recognition. His fear often is that in giving it recognition, it will take over. The undifferentiated aspect of a male usually concerns his feelings.

ELIZABETH JOLLEY

Noted WA novelist and academic

We have a small country property, and I dream repeatedly that I'm there, but that the whole slope of the land is different. Every time I dream it the land is sloped, and has a curling track which goes down below an orchard, and there's a small wooden house just above that. It is always early evening, with long shadows cast by the trees. The slope of the land and the light is really beautiful. It's always exactly the same place, but it's not the place we own. I always have a strange feeling, when I wake up, that I will go there one day. Then the dream becomes anxious and nightmarish: I'm there without provisions, with no heating – all the things a mother of a household is meant to provide I haven't got. I'm realising while I'm there that it isn't my place, but that doesn't matter. What matters in the dream is that I'm not prepared for all the things one is supposed to be prepared for. It's rather sinister. The inside of the house is completely comfortless. My children are long grown up, yet in the dream they are still young, but only present in a shadowy way. I'm very aware that they are waiting for their meal and I have nothing to give them. I don't move around much in the dream. I'm static once I'm inside the property

Evening time is suggestive of the later stages of life, and the different slope could be symbolic of a sloping away from life. The sense of inevitability conveyed in the phrase "I will go there one day" adds to the thought that this dream is about death. The second part could be portraying the theme of the dreamer being unprepared, not having the appropriate provisions and perhaps not having reflected upon death since her children were young, or perhaps since she was a young child. It is also possible the children represent creativity and that the dreamer's creativity needs the awareness of death and dying as a part of caring and nurturing the creativity itself.

RACHEL BERGER

Comedian

I'm in a hotel room, a regular motel, nothing expensive, with an ex-boyfriend from a relationship which finished a long time ago. He wrecks everything – destroys the paintings, rips the carpet, breaks the furniture, and tears the mattress in half. Then he leaves. I was just watching, an observer, there was no sense of being threatened. I wasn't scared, but was horrified at him destroying everything. It was as though I was there to see everything, but wasn't actually in the room.

Hotels are places of transition, not places where we live. Jungians assume all figures in dreams are aspects of ourselves. A male figure is the masculine energy within a woman. This dream is depicting a predominately negative and destructive energy. The dreamer unconsciously sees herself as both not responsible for this destructiveness and also unable to do anything about it. This pattern maybe particularly acute at times of transition, as suggested by the hotel.

Hopefully these brief comments provide some guidelines as to how dreams can provide images of our inner life. Final meaning of a dream can only be derived by discussing with the dreamer the personal feelings and associations that form the plot.

DREAMS COLLATED BY FIONA SCOTT-NORMAN

A therapist's nightmare

Dreams bring the conflict between researchers and psychoanalysts to the surface. Yet logic and a desire to know the truth drives both groups on. One psychotherapist finds the conflict disturbing.

BY PETER O'CONNOR

When I read the laboratory studies of dreams and dreaming, I am inevitably left with two distinctive perceptions. First, there is an awareness of a sort of manic, triumphant spirit that tends to convey a message something like "There, we told you all along that dreams were nothing more than a neurological phenomenon". The second perception I have results in a passing thought of Flat Earth theorists and geocentric views of the nature of the universe. I start to fantasize about Galileo and Copernicus and think about how the church persecuted them for daring to think beyond the accepted, orthodox and approved line of thinking.

Common to both these perceptions is the underlying theme of the desire for control. These three feelings: of triumphing over, contempt for, and control of, are readily recognised in the psychoanalytic world as the nucleus of the manic defence mechanism that protects us from profound feelings of loss.

But what is lost? And why do these scientists want to control the world in preference to understanding it? I believe the answer in part lies in the very mystery of dreams themselves.

Dreams pose such a threat to the rational order, their very existence undermines the deification of logical positivism. They represent a diabolic intrusion into the rational view of the world. Finally, they establish that the ego is not master in its own house, that psyche or soul is far more than ego. In short ,dreams threaten the territorial claims of rationalism. Little wonder that those involved in laboratory studies of dreams gleefully claim the "nothing more than" line coupled with the obsessive need to control the outcomes of dreams. In this way the rationalists can reassure themselves that all is well, the ego is back in control. This strikes me as the psychological equivalent of a geocentric view of the universe, a refusal to see that the psychic world does not revolve around the ego, but the ego around it. Then comes the persecution of any alternative views, so Freud has to be denigrated and Jung ignored, like a modern day Galileo and Copernicus. They dared to challenge the biological metaphor, dared to suggest that more than the obvious exists. But the contemporary Flat Earth theorists, in the disguise of empiricists, assert the "facts" as "proof": that any other view of the dream is seen then as fanciful and erroneous. Of course, they fail to see that they themselves are caught in a fantasy, the fantasy of facts as they need to render the mystery of life and dreams mundane, in order to fulfil their obsessive need for control.

But to equate some interesting knowledge concerning the physiology of dreams with an understanding of dreams is to mistake the map for the territory. It seems to me a little like assuming that in knowing how books are printed, the technology of printing, we are at the same time able to know how the writer managed to find his inspiration for the written content. We are unfortunately in an age where one myth is so utterly in ascendance, the myth of rationalism and logical positivism. It is of utmost importance that we recognise the need to have both a rational and an imaginative, an exoteric and esoteric view. Otherwise we will witness the same splits that have occurred throughout history, alchemy and chemistry, biology and the bestiaries, astronomy and astrology, all splits that occurred in the mid 17th century. The end result is that both endeavourers suffer, one side, the left side, becomes inflated and the other denigrated and driven to the fringe where it gets locked into cults.

The laboratory studies of dreams threaten this split again. To suggest as Hobson is quoted as saying that a dream is nothing more than spontaneous electrochemical signals in the brain is to commit the most appalling act of literalism, of no value at all in advancing understanding. Indeed it is a fine example of the masculine ego on a rampage. There is a great mystery in this phenomenon of dreams that goes back in recorded history as far as the epic of Gilgamesh and the recorded dream of Gilgamesh dated approximately 4600 years ago. There is also the cult of Asclepius, the God of Medicine in ancient Greece where healing of physical ills was administered through dreams, not antibiotics. We need to respect this mystery without idealising it on the one hand in cultish practices, or denigrating it by regressing it to mere physiological explanations on the other.

Even more important is the need to avoid both extremes when the word psyche itself is focussed on. Since psyche in ancient Greek translates as soul and soul is the imaginal realm of being, that is in terms of the alchemical metaphor, it is soul that binds body (salt) and mind (sulphur). It is the quality that joins and holds together both the rational and the literal.

To idealise dreams and render them beyond investigation by elevating them to mystical beliefs, as the New Age is apt to do, is just as destructive as insisting on their secular mundanity as the scientists would have us believe. It is reverence for their mystery we need, not adoration or denigration, since here we can see a capacity in human beings that goes beyond anything we know consciously. Who or what does the dreaming? And how can we produce such rich and often incredibly precise imaginal stories when we are asleep?

It is in this symbolic forming capacity of human beings that we seem capable of knowing far more than we can know consciously about ourselves, for a symbol, as Jung reminds us, is the best possible expression of something that we have not yet understood. It is also from precisely this same imaginal space, this psychic space that one can broadly term the unconscious mind, that all art and creativity emerges. It is from here that culture itself is formed. That the rationalists and empiricists exist at all is, of course, evidence of one product of the unconscious world, one image. It is just unfortunate that it fantasizes that it is the only one.

The language of dreams is not a conceptual language, it is an imaginal language, it is art, not science, it is right-hand brain not left-hand, it is esoteric not exoteric, it is the alchemy, not chemistry. In the final analysis the imaginal language can be seen as the language of feelings, both repressed feelings and other feelings that we have not even yet rendered conscious. Respecting the feelings and the understanding that comes with them helps us to sustain our development and evolution as a species. To declare one truth categorically, the physiology and factual truth in the case of laboratory studies done on dreams, is of necessity at the expense of the appreciation of the truth itself. Surely someone who claims that they have the truth has, at the very same moment, just lost it.

But the literalists are preoccupied with "having" the truth, possessing it, rather than participating in the struggle towards it. Dreams themselves are a constant reminder of our relationship to truth as always being in a state of potentia, in a state of progression towards, not possession of. As Jung so poignantly reminds us: "The dream is a little hidden door in the innermost and most secret recesses of the soul, opening into that cosmic night which was psyche long before there was any ego consciousness and which will remain psyche no matter how far our ego consciousness extends".

Dreams, then, provide us not only with rich and precise insights about ourselves that are so often contradictory and offensive to our ego positions, but more importantly they are a conduit to the deeper truths, not only of a personal level but also of the transpersonal. They connect us to our self and the universal self. The disputing of this can only be achieved by a gross denial of the content of dreams, their rich and intricate symbolism, all of which is usually denied in laboratory studies. To only take a scientific attitude towards the phenomenon of dreaming is to leave out half the picture, since dreams are the poetry of the psyche, the alternative and hopefully complementary view to rationalism. While we project out on to the world many dangers and threats to our survival, in my view the major threat is the sickness of literality and the loss of the imaginal life. In imagination we can discover the depth of our feelings, whereas in literality we propel them out on to the world and others who then become our enemies, separate from and different from us. Dreams and dreaming, through their revelation of the rejected and despised aspects of ourselves and the bringing into consciousness of the universal themes via archetypal images, finally enable us to feel compassion and respect for the universality of human life, a position from which destructiveness is less likely to be acted out.

As well as this general theme of difference between the empirical or laboratory approach and the imaginal, there lies the very specific difference of respective languages of the two realms. The language of science is conceptual and the form logical, the language of dreams is symbolic and the form metaphorical. To this end both art and poetry provide the appropriate comparisons for understanding dreams. For both these activities, the task is to communicate experience, and this communication is by way of picturesque imagery rather than the enumeration of facts. Within this context, metaphors and puns are the most striking aspect of the dream language. It is by exploring and amplifying the pictures, much as one would a poem, that the feeling or experience being communicated can be understood consciously.

Take this simple example of part of a dream of a man in his late thirties undergoing individual therapy: "Prefabricated plumbing stacks are being delivered to a different construction site. One such conglomeration of pipes requires a waste outlet which has not been provided for in the building. A decision is made to simply connect the waste outlet to an adjacent fire hydrant."

While one could say many things about this dream, the central point of note is that no waste outlet has been provided for. In other words, this man has no outlet for his waste feelings, his negative feelings. The only solution he seems to know is to connect them to a fire hydrant, and immediately one can imagine what will happen when the fire hydrant is turned on. This is the dream of a man who had considerable difficulty in actually expressing his negative feelings, which predispose him to moodiness and a sense of despair. The dream indicates that the only pictures he has for expression of "waste" feelings is either no outlet at all, which is going to make a rather unpleasant mess inside in the form of moods, or alternatively to spray them forcibly over the place in response to any fiery feelings. Such dreams provide one as a therapist with a very valuable self diagnosis of the underlying problem.

Another brief dream of a woman in her late fifties demonstrates the position of the choice of symbols in a dream and the highly relevant informative view it can provide of the issues that underlie the dreamer's problem: "Trying to keep a little kitten outside the kitchen door, but it eventually sneaks back in while I am washing the dishes. When I am not watching, it falls into the dishwater. I use a small plastic container to scoop it out, and as this container is full of water I notice it has drowned in it. I just leave it there, looking at it".

Mandala by Carl Jung: once a mandala appeared in Jung's fantasies he set about uncovering its meaning

One could make many comments about a dream like this, but if briefly one reflects upon the image of a kitten it becomes fairly immediately obvious that playfulness, mischievousness and curiosity will be attributes of a kitten. Likewise the washing up is inevitably located in the kitchen sink and the kitchen sink and washing up are equally and inevitably places of drudgery and utility. The old saying "tied to the kitchen sink" depicts these qualities. So the essence of this dream could be seen as suggesting that for the woman her spontaneity and playfulness are kept out of her life, and indeed, even when they sneak in they are drowned in the chores of life depicted in the washing up water. She was indeed a woman for whom playfulness, fun and spontaneity were markedly absent and duty and obligation were the hallmarks of her life.

The Dream brings into consciousness these issues and reveals precisely how she is failing to acknowledge and care for these qualities in herself. Here we see that dreams are far more than mere wish fulfillment of repressed urges. They are pictorial and imaginal representations of issues in our lives and often go further to provide insightful solutions. All this when we are asleep.

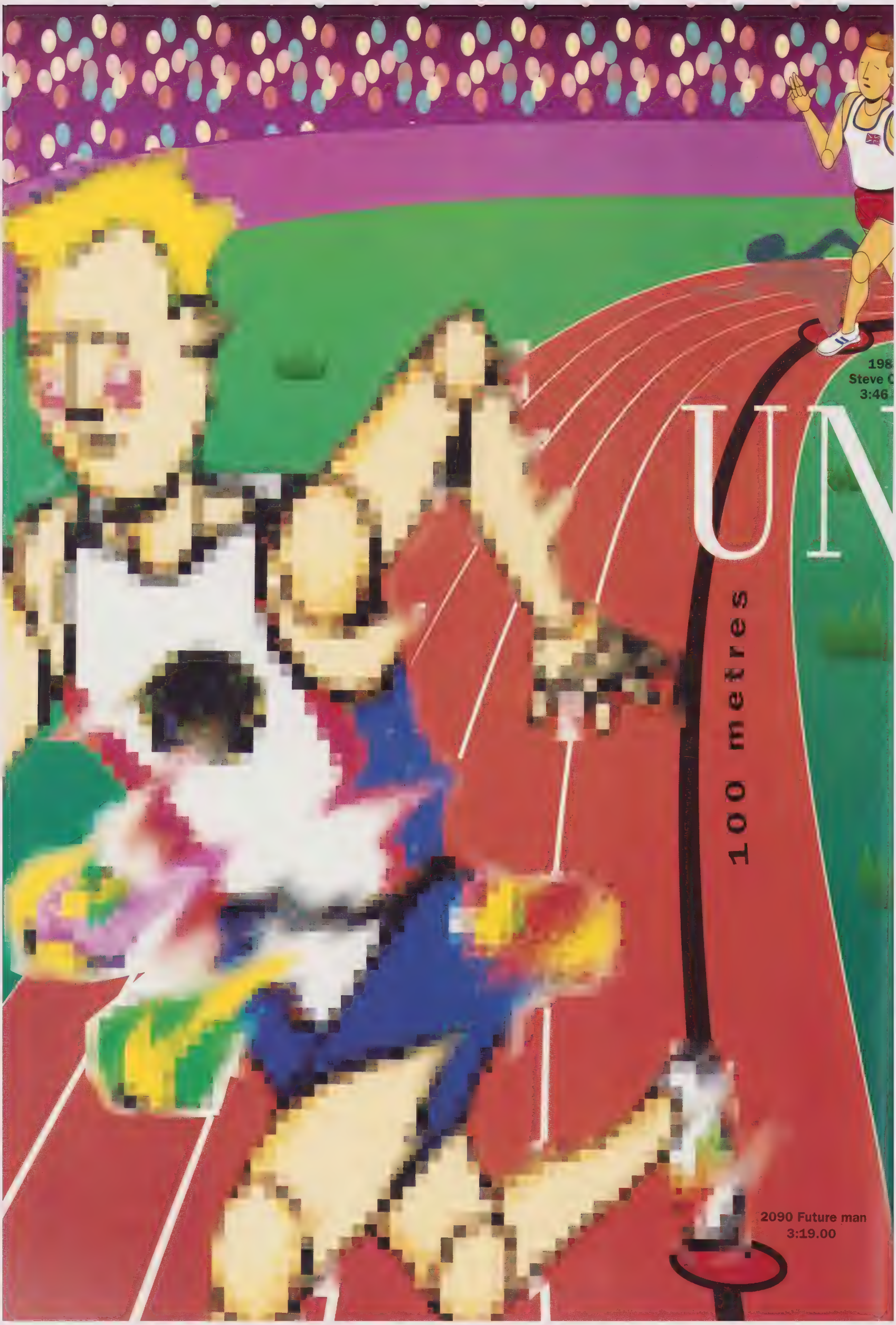
Finally, dreams often reflect very powerful themes, themes that appear to belong to the realm of mythology and go beyond the personal issues. Jung refers to these dreams as archetypal. They are perhaps the type of dreams that ancients refer to as messages from the gods. The following dream is a fine but simple example of such a dream. It is a dream that was recently dreamt by a member of one of my dream groups. The woman is in her late forties and is a very creative person, open to the wisdom of her unconscious.

"Walking along a track, a butterfly landed on my shoulder. It was very brightly coloured. I lifted it on to my hand and carried it for quite a long time. I then walked down steps into a dark cellar/cave-type room when the butterfly transformed into an old man. He seemed to be waiting for me.

"The cellar was dark and appeared empty. The man lit a candle and handed me a piece of chalk, and gestured towards the black rock wall and spoke. He told me to write on the wall something important. I wrote: "What is most important is invisible to the eye". I turned around and the old man had disappeared and in his place was light. I then noticed on the other wall a painting I had painted years before".

Without going into the details of this dream, it becomes immediately apparent that it has a particular quality of feeling about it. What is striking about the symbolism is the transformation of the butterfly into the old man and the wisdom that the dreamer herself is able to communicate in the dream when she writes on the wall "What is most important is invisible to the eye". A dream like this, of which I have been privileged to have shared many times over the years, is a striking reminder of the depth and wisdom that lies within each of us that manifests itself in the dream world. While laboratory studies can certainly assist us in revealing the mechanisms of dreams, the source and content of the dreams continues to remain a mystery, forever calling us towards the truth about ourselves.

Dr Peter O'Connor is a psychotherapist who specialises in dreams and conducts weekly dream groups as part of his clinical practice. He is the author of Dreams and the Search for Meaning" (Methuen 1986.)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STOPPABLE BODIES

The machine that goes faster, further and higher all the time . . . the Human Machine

BY KENNETH DYER

The title of the world's fastest human can still be jointly claimed by Canadian Ben Johnson and American Carl Lewis. In the Seoul Olympics, Johnson ran 100 metres in 9.79 seconds and Lewis 9.92 seconds. But between 50 and 60 meteres, both men achieved a top speed of 12.1 metres per second, or 43.6 kilometres per hour. (Johnson won the race largely because of a much superior start.) Lewis, Johnson and other top athletes, including the new world record holder Leroy Burrell, are able to maintain top speed for about 50 metres. Ben Johnson was subsequently disqualified for using drugs and his world record was disallowed. But his performance still stands.

In the 200 metres final in Seoul, Lewis's time was 19.74 seconds, less than twice his time for the 100 m (2 x 9.92 = 19.84) and he covered the 100 metres between 50 and 150 metres in this race in 9.21 seconds. But this section of the race is run on a curve which undoubtedly reduces speed. Presumably, if the 200 m were run on a straight track, Lewis, the Olympic Champion Joe De Loach and others would be able to run even faster and complete that middle 100 metres in perhaps 9 seconds flat, an average of 11 metres per second, or nearly 40 kilometres per hour.

Is this the ultimate speed of which humans are capable? What of longer distances?

One hundred years ago the world record for the mile was 4:16.2, set by Englishman Walter George. Fifty years ago it was held by another Englishman, Sidney Wooderson, with a time edging close to the magical four minutes, of 4:06.49. The four-minute barrier was finally broken in 1953 by Dr Roger Bannister. The world record today is held by yet another Englishman, Steve Cram, at 3:46.32.

If these four men were able to compete against each other, Cram would finish fully half a lap in front of George, 150 metres and more in front of Wooderson and perhaps 100 metres in front of Bannister.

If there is similar improvement over the next 100 years, the mile will be run in about 3:19. The winner would finish more than 100 metres ahead of Cram. Will this really happen? What were the reasons for the 14 per cent improvement in time for running the 100 metres, the mile and all other distances (see Table 1) over the past 100 years? Better training? Better tracks? A greater willingness to punish the body for greater rewards – fame and fortune? Or are humans simply becoming bigger, stronger, faster, as a result of better diets, fewer illnesses, and possibly selective breeding?

Will it be another Englishman holding the record in 100 years, or might it be a Kenyan or an Ethiopian, to

NORMAN ROBINSON

WORLD RECORDS FOR RUNNING RACES

	1891 record		1991 record		2091 prediction+
100 m	10.75	L Carey (US)	9.92	Carl Lewis (US)	9.15
200 m	22.00	L Cary (US)	19.72#	Pietro Mennea (Italy)	17.66
400 m	48.20	L Turdall (GB)	43.29	Butch Reynolds (US)	39.50
800 m	1:53.70	F Cross (GB)	1:41.73	Sebastian Coe (GB)	1:31.03
1500 m	4:24.60	J Barel (Fr)	3:29.46	Said Aouita (Morroco)	2:59.82
Mile	4:16.20	W George (GB)	3:46.32	Steve Cram (GB)	3:19.96
5000 m	14:29.60*	J Kepplewhite (GB)	12:58.39	Said Aouita (Morroco)	11:34.73
10000 m	30:21.50**	W George (GB)	27:08.23	Arturo Barrios (Mexico)	24:15.60

#This is the time set at high altitude. Carl Lewis and Joe De Loach hold the low altitude 'record' at 19.75.
*3 miles, **6 miles
+Based on the simple assumption that the rate of improvement in the next 100 years will be as great as in the last 100.

Table 1

suggest two countries which have recently become prominent in running. Or might it be a native of some totally unexpected country which has not featured in athletics at all?

The field events are quite a different story. Improvements of 50 or 60 per cent or more are the rule. Not all records are directly comparable with those of 100 years ago because of changes of rules and conditions. Ignoring that for the moment, their improvements over the last 100 years and predictions for the next 100 if similar increases are maintained are shown in the charts.

Do we really believe these apparently ridiculous predictions for 2091? Haven't the limits already actually been reached?

People have certainly believed that in the past. As long ago as 1916 an American statistician, G. P. Meade, concluded that: "any marked change in the records ... is very remote". In 1926 Meade wrote that "records in the next 30 years will not improve as much as in the past 30" and described all talk of a four-minute mile as "fantastic." "A study of the record books proves that such a performance is beyond the realm of reason. Paavo Nurmi's record of 4:10.2/5 is an almost superhuman feat." Meade and a host of other "experts" were wrong – absurdly wrong.

WORLD RECORDS FOR FIELD EVENTS

	1891 Record	1991 Record	2091 Prediction
High Jump	1.96m	2.44m	2.92m
Pole Vault	3.58m	6.06m	8.54m
Long Jump	7.47m	8.91m	10.60m
Shot Put	14.22m	23.12m	32.02m
Hammer	43.21m	86.74m	130.27m
Discus	26.20m	74.08m	121.96m
Javelin	37.82m	90.98m	144.14m

Taole 2

Ten years after Roger Bannister's four-minute mile, when his record had been improved by 5 seconds to 3:54.4, he predicted that the ultimate performance in the mile "must be three and a half minutes." John Walker, mile record holder from August 1978 to July 1979 and the most frequent sub four-minute performer in history (he actually ran more than 100 of them), said of the mile record: "I feel it's only started to come down in the past 3 years ... I don't feel the mile is anywhere near what it should be run in. It should be around 3:45."

A more recent champion, Sebastian Coe, also believes records can be substantially improved. In his 1981 autobiography, *Running Free*, he says, "This time I hope not just to nibble the records but to improve them substantially. What I really want from athletics is an 800m under 1:42, a 1500m under 3:30 and a mile under 3:47."

Shortly after regaining the world mile record with 3:47.33 in 1981 he said, "I don't think the mile has really been tapped yet. The time will come down by running more courageously at the start than at the finish. I believe this is a psychological problem above all. From the moment one believes that something is possible, one no longer creates a blockage. You can go beyond your imagination and reason."

Probably the most successful miler of all time, Australian Herb Elliott, puts similar emphasis to Coe on what might be called a "mind-over-matter" approach. He believes that there is enormous improvement yet to come in the middle distances and that much of this improvement will come from advances in understanding about how the mind governs the body.

He contends that before the Second World War athletes treated their involvement in running as something to be enjoyed. The commitment to effort and pain in races was much less than in his era and after, where a much greater dedication in training was coupled with a much greater commitment to racing. The mental preparation for races also came to be taken much more seriously.

He suggests that expectations changed in a stepwise fashion each time a record was broken. Top runners were much readier to believe that a 3:58 mile was possible when someone else had already run 3:59. Given a time of 3:33 for 1500m for him to beat, he believes he could have hit 3:32.

He also predicts that there will be a quantum leap in performances when there is a breakthrough in understanding about how the mind governs the body and allows it to release energy. At present, he says, our understanding of this mechanism and our attempts at psyching up are relatively crude.

THE CONTINUING EVOLUTION OF HUMANS

For most of the past 100 years, athletics and most other sports have been dominated by Europeans and expatriate Europeans (Americans, Australians, New Zealanders etc). The principal exception to this has been sportsmen and women of whooly or partly of African origin, although they have been largely from the western cultures of the US, the West Indies and Britain. Only in the last two or three decades have distance runners from East African countries such as Kenya, Ethiopia and Djibouti and sprinters from West Africa begun to make their marks in the record books.

Part, but only a part of the improvement in world records and performances generally is because Europeans have been getting taller (and heavier and stronger) over this 100 years, so that more taller and stronger people are available for sport.

A sample taken of soldiers in the American civil war measured them at an average of 164.5cm. First World War soldiers averaged 171.4cm, whereas those in the Second World War averaged 172.9cm. In other words Americans, or at least their soldiers, increased in height by about 12mm per decade 1863-1942. Indigenous Europeans showed similar increases. Swedish soldiers, for example, averaging

Where the impact strikes: Artificial rubber soles on bare feet may lead to records if runners abandon conventonal spikes.

165.4cm in 1840 and 172.8cm in 1927, increased in height by 9mm per decade over this period.

But societies are not homogeneous. Harvard students who might be assumed to be among the more affluent of Americans, averaged 172cm in 1880 and 178.0cm in 1925. They were not only taller than their compatriots but showed an increase of 13.3mm per decade, rather greater than other American males.

In Britain in 1980, 20-24 year old men of the upper class averaged 178.0cm, whereas men in the two lower classes were only 174.9cm. These class differences are not so much genetic as a consequence of the better diet, healthcare, lifstyles and chances which still mark class differences in western societies. It shows what potential for improvement still exists worldwide.

As well, the undoubted increasing opportunities for top athletes to marry and produce children who *may* inherit some of the favourable genes which their parents have and who *may* wish to take up the sport *may* contribute to increased record breaking in future.

Genetic inheritance is a lottery, but the more frequent are the unions between athletes of the calibre of Lisa Curry and Grant Kenny, the more likely it will be that future champions and record holders will appear – as much because of the environment they create as because of the genetic endowment of their children.

There are other important differences in people around the world which are genetic and which probably will in time have profound effects on sporting world records. The Nilotic people of East Africa average more than 185cm. Giants of well over two metres are quite common. What will happen to the high jump record when they take up organised athletics, as they will one day?

It may be the case that the world's finest distance runners are to be found not on the running tracks of Europe, America or even Kenya but in the isolated Sierra Madre mountains of north west Mexico, at an altitude of more than 2200m. Living there are a tribe of Indians, the Tarahumara, whose main recreational activity as well as principal means of travel is long-distance running. These people, it is said, think nothing of running 40km to visit a relative, having a meal and returning – all within 5 hours. For sport they will run 'short' races of up to 80km and in cases of strong rivalry or heavy betting, races of up to 350km.

Their alleged achievements are fantastic. It was reported in 1954 that a Tarahumara had run 1500m in 3:9.0 and 10, 000m in 23:48.0. But he failed to put in appearance for the Central American Games held in Mexico City that year and was never heard of again. In the 1960s the Tarahumara had, apparently, a great runner called Sixto who used to give his opponents 5 minutes' start in a 25 mile race and still beat them. He was offered the chance to be taken to Mexico City for a reward but never bothered.

Two Tarahumara were chosen to run in the 1928 marathon in Amsterdam. They were brought from their mountain home to Mexico City and told to run to Toluca 70km and back. This they did. Then they were shipped off to Amsterdam without any other training or mental or social preparation. The marathon course had been newly tarred and the barefooted Tarahumara, disliking the sticky surface, lost interest after a few kilometres and retired.

Whatever the truth or possibilities of hitherto undiscovered talent around the world, those who have competed and set records have been getting taller over the years. The events in which height confers most advantage are the sprints, the shot put and the high jump. In each of these competitors have been getting taller, often dramatically so.

All things being equal – which they never are – the person with the longest stride will run fastest. Stride length is primarily determined by two things : leg length and hip flexibility.

To compensate for a shorter stride, runners can move their legs faster, since speed is the product of stride length and stride frequency. Simply stated, you can increase your speed by taking more rapid steps or by taking longer strides, or both.

But on average, tall people with longer legs are faster than short people. For similar reasons it is tall but not heavy people who are able to jump highest and tall, strong but fast and flexible people who excell in the throws.

The increases in height may continue – if they do Australians may be, on average, 10cm taller in 100 years than they are now. But unless specific height and weight groups are introduced into athletics (as is the case in boxing, wrestling, weightlifting and judo) those events in which height and weight confer advantage will be dominated by East Africans, South Americans and possibly some Asians. And the men who win them will be jumping more than 2.6m, putting the shot more than 30 metres, running 100m in 9 seconds and the 400m in about 36.5. Australians will not get much of a look-in.

INCREASE IN HEIGHT OF SELECTED COMPETITORS 1928-1988

Average height in cm of finalists

	100/200m	400m	High Jump	Shot put
1928 Amsterdam Olympics	172.5	172.5	—	182.0
1960 Rome Olympics	176.1	176.3	187.1	187.0
1964 Tokyo Olympics	175.2	177.0	185.0	190.0
1968 Mexico Olympics	175.4	181.0	188.5	194.6
1972 Munich Olympics	175.8	178.9	188.6	191.0
1976 Montreal Olympics	177.2	185.8	188.9	193.4
1980 Moscow Olympics	177.8	182.1	191.0	193.0
1983 Rome World Champs	181.8	181.9	192.3	192.8
1984 Los Angeles Olympics	182.0	180.0	193.0	193.0
1987 Tokyo World Champs	182.0	181.0	194.0	193.0
1988 Seoul Olympics	183.0	183.0	195.0	193.0
Average increase per decade 1928-1988	17.5mm	17.5mm	28.2mm	18.3mm
Average increase per decade 1960-1988	24.6mm	23.5mm	42.5mm	21.4mm

Table 3

SPORTING FAMILIES

DIVE, SHE SAID

The Donnets, Divers

IRENE ELLISON, 73: *Won the Empire Games in 1936.*
I started diving in 1926, and if we did an hour's training we thought we'd done an awful lot, and Dad (the coach), was very hard on us. We trained every day. We had six dives to do in a competition, and we had to do two good ones of each dive before we could go on to the next one. We'd go through all six that way. That was our competition training, and it was never longer than an hour. If we were trying new dives we'd put on jumpers and long trousers, so we wouldn't hurt ourselves. The boards in those days were just planks, and had no elasticity.

BARBARA DONNET 62: *Australian champion for the first time in 1951, champion for six consecutive years. Won Commonwealth Games in 1954, went to Olympics in 1956. Coached by husband.*
We used to dive off wooden boards covered with thick coconut matting, and we had to use a lot of strength to get off them. I used to do an hour of calisthenics before I got on the board, then I would train one and a half to two hours non-stop, and I'd do that six days a week, practising all the different kinds of dives we had to do. There are five different groups of dive. We didn't really train for those dives in any other way apart from diving, we just got up and had a go once we had it in our minds what we had to do. I'd put a jumper on, in case I landed flat and hurt myself, and then I had a go. It always came off, because I was too scared to hurt myself. They are very big on the splashless entry these days, and we didn't have it at all back then.


DAVID JOHNS

Tradition spans generations: Irene, Barbara and Jenny share a love of water.

JENNY DONNET, 28: *Won the Commonwealth Games in 1982 and 1990, is aiming for the Barcelona Olympics in '92 which will be her fourth. Has won four World Cups.*
I learn new dives with a dry board and harness; essentially you learn the aerial work – the somersaults and twists of a new dive – on the trampoline, then take it onto a dry board, a one-metre board with a high-jump mat underneath. That's also rigged with a harness which is controlled by the coach, to stop you landing badly. Then you take it onto a one-metre board, and we have what is called a bubble, which is tanks of compressed air under the pool, and when that's released it forms a cushion of air which cushions your descent if you land on your back or your front. Then you take it up onto the three-metre or the tower, and when you feel confident you take the bubble away and do the dive on its own. I do 90 minutes of weights five times a week, to strengthen and tone up my legs and streamline my body. In the low season I practise diving six nights a week, in competition training I do 10-12 water sessions a week, which last about two hours each. I do an hour of visualisation every day – visualising the dives and the techniques, making sure the timing is right in my head. We have theory work twice a week for three hours and watch videos on technique. I run one sprint session a week, and 2km five times a week. We also have skinfold fat tests. We have an eight-point skin test, and the total sum has to come to 100mm or under. I have a higher fat content than most of the divers these days because I'm older. They call me Grandma.

FIONA SCOTT-NORMAN

BULLY FOR THEM

The Warks, Hockey Players

HARRY WARK, snr, 67: *Played for Glebe Firsts in the 1940s.*
Running was basically all we did – round the oval a couple of times a week. Then we'd split into sides and have a game. We were very dedicated.

DR HARRY jnr, 40: *Played for Glebe in the late 1960s.*
We used to do a few laps of the oval and a few push-ups and situps. Then we'd practice dribbling, hitting, pushing, and work on how to out-manoeuvre other players and tackle. Then we'd have a game among the players. We trained once a week, and played once a week.

LES WARK, 36: *NSW Assistant State coach, State seniors player in the early 1980s.*
When I was playing State I was training five to six days and playing games twice on the weekend. We were mostly doing circuit work three times a week, and running long distances. We would also run 10 metres, do 10 different exercises like sit-ups, push-ups, tuck and star jumps and knees-ups, then short sprints, and then repeat the whole thing. I'm not sure why we did them, it was just the trend at the time. We ran a lot of hills and distance, for about 45 minutes every morning. A mate and I used to go to the park five days a week, and hit a golf or tennis ball against the toilet block wall, and play one-on-one. Training is a lot more specific these days.

KEN WARK jnr, 30: *With the current Australian team since 1985.*
I train four or five days a week, plus two games on the weekend. We train three times a week on artificial turf, doing stick and ball work for two hours. They video-tape our practice, and we watch it to see where we're going wrong, and talk about how to improve our play. We use slow-motion to highlight our mistakes. This includes theory and technique sessions. We have a weights program, which increased our speed and stamina. The sessions take 90 minutes, and we do bench presses, squats, press-ups about nine exercises in all. We do stretching exercises to increase our stride by a couple of centimetres, and resistance running, where someone holds tightly to you while you try and run between five and 10 metres; it's a bit like being a horse. We do long-distance running to improve our endurance, about 7 or 10km three times a week at the beginning of a season, and further in we do sprints instead. We are also tested after exercise on the amounts of heart beats per minute, to teach our bodies how to recover faster.

FIONA SCOTT-NORMAN


PETER SOLNESS

Wark's the name, hockey's the game.

TECHNOLOGICAL ADVANCES

It is little more than 100 years ago that the crouch start was introduced into athletics. This gave greater stability in the set position and greater velocity from the gun because of the flexed position of the legs working on a horizontal track. A slightly greater force could be obtained from holes dug in the track; but when athletes started digging such holes, a decision had to be taken as to whether such an innovation was fair and in the best interest of the sport. Starting blocks were not introduced until 1929 and they were promptly objected to as artificial aids.

The IAAF did not sanction them for record purposes until 1948, the year they were first allowed in the Olympics. Even now the rule governing their use says that they must not confer an unfair advantage on a competitor, whatever that means. In other words changes in the rules and conditions have always been part of athletics. They are likely to be even greater in the next century.

• Improvements in Equipment

Apart from the obvious areas of training, nutrition and the dubious use of drugs and stimulants, there are several areas in which improvements will occur in future. These include:

- the design of the clothes and shoes ;
- the shape and surface of the tracks ;
- the conditions under which field events are held (throwing area, aerodynamics of implement etc);
- techniques of running, jumping and throwing, as a result of detailed experimental and photographic analysis;
- starting equipment and techniques (mainly of value to sprinters and hurdlers, of course); and
- sporting facilities altogether.

Grace, energy and an hour of visualisation every day: "Grandma" Donnet at play.

Reducing the weight of the shoes and clothing for runners and jumpers is a good place to start . The weight of shoes increases the amount of work that must be performed as each foot is lifted and accelerated forward at each stride.

At a speed of 4.5mps, or 16 km per hour, marathon speed, the total extra energy expenditure of an athlete wearing 100 gram running shoes is about 1.4 per cent. In other words, one runner wearing shoes 100 grams lighter than another could run about 1.4 per cent faster. This translates into 20 seconds or so in a 10,000m race, or more than a minute in a marathon. Quite a few successful distance runners have run without shoes, including Ethiopian Abebe Bikila who ran marathons on hard road surfaces barefoot. If his feet could stand the test, the advantage it gave him was considerable. Spikes prevent an athlete from slipping, but experiments with thin layers of rubber solution applied to runners' feet could lead to great improvements, especially in times for sprint races.

Changes in the clothing worn probably have less dramatic effects but may bring useful improvements, particularly, again, to sprinters.

Studies on skiers in a wind tunnel show that at wind speeds of 80 km per hour (22.2m ps), the increased drag produced by large boot buckles added 0.03 seconds per minute to a downhill racer's performance. Speed skaters wear close-fitting wind suits with hoods to minimise drag. Similar suits are now being adopted by sprinters. The sight of swimmers with shaven heads is by no means unusual. In January 1967, Sylvia Ester of the GDR established a new world record for 100m freestyle swimming naked. It is unlikely we will see that repeated on the track.

• Changes in Conditions

Today, virtually all major events are held and all records are set on so-called artificial surfaces; but the nature of such surfaces is continually changing, and improvements on performance for this reason alone are likely to continue.

One of the most important features of a track is its compliance – its springiness. Running on a very springy surface (such as, for example, a diving board or a trampoline) slows a runner down, mainly because the time spent rebounding from the surface is increased. This suggests that the hardest track surfaces would be fastest, but this is not so. A compliant surface acts as a spring and if the stiffness of the spring is closely tuned to the mechanical properties of the runner, their speed increases. In other words, there is some optimum compli-

PETER SOMMERS

Ken Wark: Weights and video replays, and running to make you feel like a horse.

ance at which, when runners place their foot on the track, it stores elastic energy in its surface, similar to the elastic energy stored in a bending fibreglass pole which is recovered as the pole straightens and propels the vaulter upward.

It is possible that tracks with varying degrees of compliance and banking could be built to suit different runners and different events. Even finer tuning for particular runners and events may become possible by hydraulic means, so that the track might change from one event to the next or even at different stages of the same race.

At high altitude the air is less dense and therefore offers less resistance to runners and jumpers. At the 1968 Mexico Olympics, held at an altitude of 2250m, world records were broken in eight of the nine men's events favourably affected by altitude. Three women's sprint records and two field-event records were also broken.

The overall effect is about one-hundredth of a second for each 250m elevation in the 100m, about twice that in the 200m, but less than four times that in the 400m since the runners are moving significantly more slowly. Were air resistance the only limiting factor, the 200m should have been run in Mexico at approximately 11.25 mps (i.e. in 17.78!) because it is at this speed that a runner would encounter air resistance equal to that encountered at sea level. No doubt other factors are involved, although this time could form the basis for a prediction of where the Altitude World Record at 200m might get to.

It will probably not be long before high altitude (above either 300m or 1000m) joins too strong a following wind as a disqualification for the recognition of a record in any event. But the construction of totally enclosed astrodomes would allow the reduction of air pressure within the dome to some minimum specified level. And the oxygen content of the air might be increased to compensate, so that middle and long-distance runners would not be disadvantaged. Indeed, increasing the oxygen concentration above normal might bring about sensational results. Since tracks within such astrodomes could be full size, the disadvantages of the tight bends of small indoor tracks would be removed.

• Greater Knowledge to the Athletes

Even-paced running is most economical physiologically. To this end, a mechanical pacemaker, similar to the electric hare used at greyhound race tracks, would be invaluable. Such a pacemaker could be set to different times – 3:50, 3:45 or 3:40, say, for the mile and might just provide the right stimulus for top athletes to really extend themselves. IAAF rules on human pacemakers are already largely ignored. What, one wonders, would be the reaction to an artificial hare? In any case, would it matter if officialdom objected? Is it not likely that the possibility of a 3:40 mile would make very attractive television and therefore be attractive to athletes, who would be amply rewarded? Not for the first time the ruling body of a sport would find itself overwhelmed by the *force majeure* of commercial reality and public demand.

The importance of knowing intermediate lap times and planning strategy around them is considerable. Paavo Nurmi carried a stopwatch in his challenge mile race against Edvin Wide in 1923, in which he broke the world record. At one stage he was 40m behind Wide. He kept to his own pace, though, with outstanding success. Today, it is normal practice to call out lap times in important races. This is expected by and is very important to top-class runners.

In 1981, Sebastian Coe had taken a shot at regaining the 1500m record held by Ovett with 3:31.36. Coe ran laps of 52.4, 1:49.2 and 2: 48.3, but these times were not passed on to the runners and he just missed the record, finishing in 3:31.95. As Coe said after the race, "There are only a few races in an athlete's career when he is mentally ready for a world record. I was ready. But to miss the record by that margin because normal courtesies are missing is disappointing." What would happen to times if runners could be in contact with their coaches by radio, say, throughout a race?

Video screens of the whole track visible from all points might give competitors a clearer picture of their rivals. Who can forget John Landy's inward glance on the final bend of the 1954 miracle mile at the Commonwealth Games in Vancouver as Bannister hurled himself past on the outside? If Landy had been able to see Bannister coming, he might have been able to gather himself for a final sprint and significantly improve his, and Bannister's, time.

The sport of athletics is an artificial one. It is quite arbitrary to run on flat surfaces for 100m, or round and round a track for 5000 or 10,000m. It is quite arbitrary to throw balls, spears, metal plates under totally artificial conditions. It can be no more or less arbitrary to allow technological aids which will allow us to see how fast humans really can run, how well they can jump, how far they can throw something. Given the technological ingenuity hinted at in this article, there can really be no foreseeable limits.

THE FUTURE

Ultimately it is the athletes themselves who will decide what the records will be in the future, irrespective of predictions by sports scientists, psychologists, technologists or whoever. The evidence in all events from the 100m to the marathon, all the jumps and all the throws is that overall standards are continuing steadily to improve. And that means records will continue to tumble, although in any one event progress will be unpredictable and erratic. We will see the three-minute mile, a nine-second 100m, a three-metre high jump, a seven-metre pole vault, a nine-metre long jump and a 1.50 marathon. Nobody, though, can predict accurately when.

Dr Kenneth F. Dyer is a senior lecturer at Adelaide University. He has carried out research on human differences and the sporting potential of men and women. He is the editor of The ACHPER National Journal and is on the editorial board of the IAAF journal New Studies in Athletics. As well as many research papers, he has written a number of books on sport. These include: Catching up on the Men, The Social Biology of Womens Sport; Running Out of Time: The History of World Running Records and, most recently, Sportswomen Towards 2000: A Celebration, on which this article is in part based.

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—George Bernard Shaw

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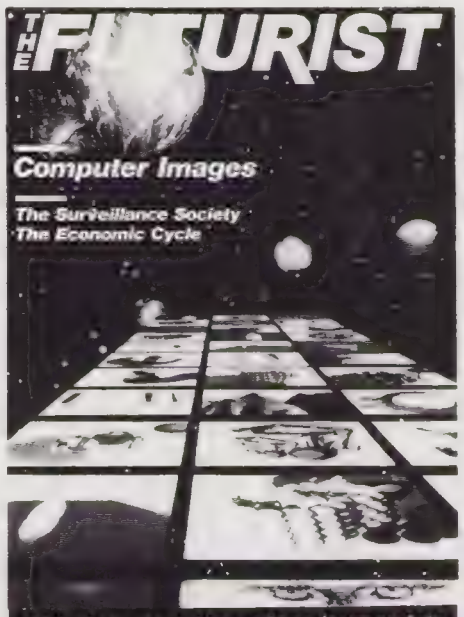

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JACK PICCONE

Crossings as we come to them

BY GRIFF CLEMENS

The 21st century could hope for no greater symbol of cooperation than a physical link between the Soviet Union and the United States. A bridge across the Bering Straits, joining Alaska to the Eastern Soviet Union, would be a structure of massive size and importance. It would require the builders to push their knowledge of materials, construction techniques and potential forms to the limit.

But such a bridge would seem just as likely to collapse from political pressure as from natural forces. The Cold War may be over, but are the two superpowers ready to share a common border? The bridge's future will be influenced by public desires and the way policy-makers respond, as well as by the genius of designers.

Faced with the most practical of problems, bridging a gap, designers have always used the latest materials and structural forms to create bridges that have thrilled the public. Roman stone arch bridges, the suspension structures of Telford, Victorian railway truss bridges and modern cable-stayed versions are powerful engineering symbols.

The great designs have had three aims – economy, safety and beauty. The 16th century architect Andrea Palladio, who built wooden truss bridges, said they must be "convenient, beautiful and durable." Four hundred years later, David Steinman, a designer of suspension bridges, commented: "I want to preach the gospel of Beauty in Steel . . . it is a material that possesses the highest potentialities for expressing the harmonious union of beauty and strength." And Lewis Mumford acknowledged the designers working in the new forms of concrete when he said: "Art uses a minimum of concrete to express a maximum of meaning."

Anyone who has been thrilled at the sight of the Sydney Harbour Bridge or experienced the sweeping approaches to Melbourne's Westgate would accept that a great bridge is structural art, created for the people and owned by the people, on permanent display and open for constant use.

Our affection for bridges may be due to a sense of shared ownership of these symbols of technologi-

Bridge

cal prowess. It could also explain the psychological attraction to those bent on suicide: sometimes the popularity of a bridge is unwanted. The thousands who crammed San Francisco's Golden Gate bridge to celebrate its 50th anniversary caused it to suffer a "permanent deflection" – it bent under the pressure of public admiration.

Creative designers working with the latest materials will continue to thrill us with the beauty of their skeletal structures, but the future of the bridge will be shaped by societies' needs rather than the excitement they create.

Between the wars, the cities of the future were envisaged as huge conurbations. Elevated skybridges, often with no visible means of support, link towering buildings. Today, these cities seem more like the way we live than predictions of the future.

Building urban skybridges between multi-storey buildings is simple engineering: one basic structure linking two department stores across Melbourne's Lonsdale Street was put in place in a day. But a political furore erupted: the people of Melbourne do not seem ready for privately-owned streets in the sky.

Freeway networks may not have the glamour of long-span bridges, but new materials and construction techniques excite today's engineers. The freeways of the '90s are being built in ways that will shape bridge construction for many years.

For flyovers and short-span bridges, concrete has a significant cost advantage over steel. Supporters argue that concrete is also a more environmentally benign material, requiring far less energy for production than alternatives. Development of reinforced concrete, where steel is encased in the material, and prestressing, where steel tendons put the material under an artificial compression, made for extraordinary advances – like the discovery of some new and highly adaptable material.

No-one envisages fresh developments as dramatic as these, but the concrete of the future will be lighter and stronger. High-strength steels and manmade fibres such as kevlar, now 20 times as expensive as traditional materials, will be used as prestressing tendons. They will lessen the phenomenon of relaxation (the "stretching" of concrete and its prestressing steel under tension) and limit corrosion. Today's lifespan of about 100 years for a concrete bridge will be lengthened significantly.

Better reinforcing and prestressing will allow engineers to build stronger beams, and lighter structures. The concrete will also become lighter and stronger. Just as the demise of the railway encouraged designers to create lighter bridges, so solar vehicles could result in new bridge forms using ultra-light materials.

Melbourne's recently built Westgate Freeway used a technology called balanced cantilever construction, where bridges are built out on either side of their piers. The freeway was made of prefabricated sections that were "match-cast" next to each other so that when they were rejoined as part of the bridge, they fitted perfectly. The giant cranes, capable of crawling along the deck of the bridge, lifted the precast concrete box sections into position. After each pair of bridge segments was in position and the structure was balanced, tensioning

JACK PICCONE

tendons were applied to form a monolithic length of deck.

Incremental launching, in which prefabricated sections are pushed out across the gap, will play an increasingly important role in short-span bridge building. A lightweight steel nose is mounted on the leading section, and hydraulic jacks push it out on to pillars fitted with special bearings to reduce friction. Once the first section is "launched," the next is pushed out. Bridges can be built with uncanny speed, but only straight or on a constant radius.

But will future cities need freeway networks? Urban bridges play little role in the Los Angeles of 2817 depicted in Ridley Scott's film, *Blade Runner*. The elite fly between corporate megastructures and the masses are likely to be huddling under a bridge, not travelling over one.

For years, thinkers have been predicting the demise of the modern city, or at least the end of the need to move around it. Cellular phones, computer interfacing and video links have substituted for face-to-face communication. Nevertheless, economic and social ties will ensure cities exist far into the 21st century: the bridge is most likely to be threatened by community attitude.

Selection of a tunnel for Sydney's second harbour crossing and the English Channel link have been seen as indications that the long-span bridge is dead, and that future projects will be buried. But designers point out that one factor in the decision to tunnel under the harbour was a popular desire not to clutter the beloved coathanger landmark.

The tunnel is also recognised as a spectacular engineering achievement, if only by professionals, yet the people of Sydney are bound to love their tunnel's effects. It will increase harbour crossing capacity by 50 per cent, reducing crossing times by an average of 10 minutes during peak periods, a saving of about 13 million litres of fuel a year.

The need for a second harbour crossing is a graphic example of the way that a transport link can reshape the population of a city. When the Bridge opened in 1932, 11,000 vehicles crossed it each day. By 1940, the number had almost doubled and population growth in the northern suburbs had been stimulated. Today it carries more than 180,000 vehicles per day and is partly responsible for the rapid commercial development of the lower North Shore.

If today's Sydney is unthinkable without the Bridge, the Sydney of tomorrow would be unbearable without a second crossing. It has been estimated that by the year 2000, more than 230,000 vehicles would be trying to cross the Bridge each weekday, with a 13-hour peak period.

The Sydney tunnel will have a reversible ventilation system and emergency louvres for smoke if fire breaks out. Radio transmitters, used to relay conventional radio stations, will be used to instruct drivers during emergencies. As with all long tunnels, tankers carrying hazardous materials will not be allowed across. The inability of a tunnel to carry hazardous materials can be an argument in favour of a bridge, yet ironically Melbourne's Westgate cannot accept LPG tankers – its cables are not protected from damage during an explosion.

In time there will be more tunnels, but because of the high cost they will not replace the long-span bridge. Switzerland's Ganter Bridge, constructed in 1980 and seen as a form that will shape future bridges, was built at half the cost of tunnel proposals.

Sophisticated computer programs already "interrogate" designs, suggesting amounts of materials required. Programs will optimise the reinforcing layout and suggest the best profiles for prestressing tendons. Their ability to handle vast numbers of calculations will allow designers to push materials to structural limits.

It will be possible for designers to "build" a bridge on the screen, testing for failure during the critical construction phase. Programs that can put structures under dynamic analysis to determine exactly what kind of loads will result in failure will be used with wind tunnel testing to avoid repeating past disasters.

Computer aided design techniques allow the viewing of bridges in three dimensions, but designers are dismissive of what they call the "black box" approach. They argue that the great bridges of the future will, like those of the past, be the aesthetic and structural visions of exceptional people rather than the computer.

Long-span bridges of the future are likely to be hybrids, both in form and materials. The dominance of the suspension bridge is being challenged by cable-stayed bridges like Westgate, and a cable-stayed Glebe Island Bridge was chosen for Sydney where shipping lanes and underwater service lines require a span of 345 metres.

In future, there will be bridges where cable stays support lightweight concrete decks, cantilevered out from pylons which also act as suspension bridge piers. Steel will become more popular as lightweight and corrosion-resistant compounds become available and the problem of fatigue, bane of many metal bridges, is overcome.

Surprisingly, timber will become more popular. New methods of laminating timber beams allow engineers to predict the material's load-bearing ability. Chemical treatment will render timber resistant to rot, and its ability to stand up to salt and industrial corrosives will make it a desirable material.

The bridge engineer of the next century will be more likely to be maintaining old structures than creating grand new designs. But the need to conserve materials and the continuing desire to create beautiful new forms will mean that the great bridges of the future will be as thrilling as the work of the great designers of the past.

Yet there will be an opportunity to create longer spans. Recent proposals for the Messina Bridge, linking Sicily with Calabria on the Italian mainland, show a bridge with a span of 3320 metres – more than twice the length of the Golden Gate Bridge and more than six times that of the Sydney Harbour Bridge. The cost, it has been estimated, will exceed $2.5 billion.

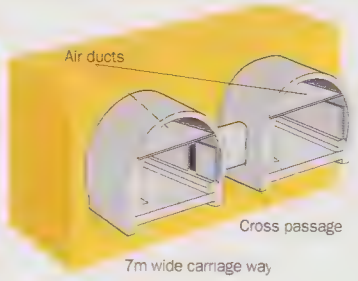
Where there is a demand, there will always be people who are willing to build beyond known limits. People like Arthur C. Clarke's hero engineer in *The Fountains of Paradise,* who builds the ultimate bridge, a structure extending from the planet to a satellite in stationary orbit. Some called the structure a tower, but the engineer insisted it was a bridge. It was important that the greatest structure ever built should be a link, a symbol of co-operation rather than dominance.

Griff Clemens is a freelance writer and town planner.

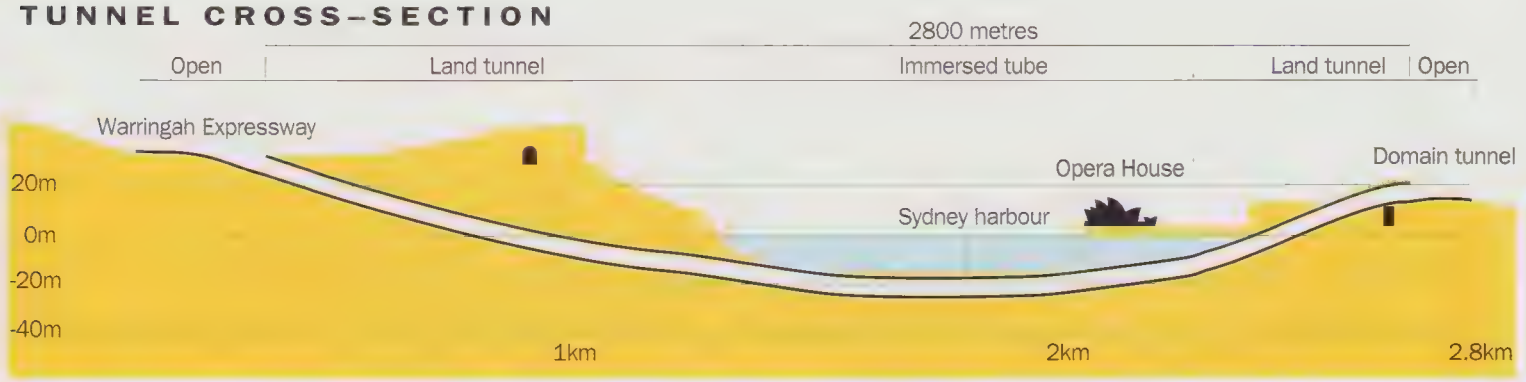
A TALE OF TWO SHORES

The Sydney Harbour Bridge and Tunnel are spectacular examples of the construction technologies of their eras and changing attitudes to large capital works projects. The Bridge was designed and constructed by the British contractors, Dorman Long and Co. Ltd., for the NSW Government. The Tunnel is a joint venture by the Australian construction firm Transfield, and the international construction group Kumagai Gumi. Building the Bridge was labour intensive, with an average of 1400 people employed during the nine years of its construction. The 52,800 tonnes of steel in its 1149 metres of span and approaches are held together by more than 6 million rivets. By contrast the 960-metre 'Immersed Tube' section of the Tunnel will be formed by the joining of eight precast concrete units – each 120 metres long, 26 metres wide, 7.5 metres high and weighing 23,000 tonnes. The use of precast components, sophisticated construction machinery and modern project management will allow the Tunnel to be constructed in about half the time it took to build the Bridge. In 1924 the Contractors for the Bridge quoted a wonderfully precise cost of £4,217,721/11/10 for their two-hinged steel arch. On opening, when the basic wage was £3/10/8, the construction cost of the Bridge and its approaches was estimated at £6.25m. The joint venturers are building the tunnel for a fixed price of $408m in 1986 values, bearing the risks of cost and time overruns. The cost in actual dollars over the construction period is estimated to be about $554m, with interest, principle repayments and other charges bringing the total to be financed to almost $750m. The final payment of all loans used to finance the Bridge was achieved in October 1988. The Tunnel will be operated privately until 2022 when, debt free and worth an estimated $2 billion dollars, it will be handed over to the State Government. The Bridge, with its 134 metre arch dominating the skyline and the 2.26 kilometre tunnel, more than 20 metres below sea level at its lowest point, will form a symbiotic partnership in the management of cross-harbour traffic. The two crossings even combine physically. The Tunnel's vital ventilation discharge will be concealed in one of the Bridge's northern pylons.

LAND TUNNEL SECTION



TUNNEL CROSS–SECTION



HEADS, VICTORIA LOSES

Sydney's Harbour Bridge has long been the country's outstanding bridge. Opened in 1932, it rapidly became a national icon to rival the kangaroo and the koala. Millions of tourists have marvelled at its postcard setting. But a plan for a long-span bridge across Port Phillip heads, proposed in 1974, would have provided a strong challenge. Politics, not engineering, makes construction of such a link unthinkable today. It calls for a four-lane approach road to the tip of Point Nepean, one of the State's national parks. This would be seen as vandalism. If such a link is ever made, it will almost certainly be by tunnel, at greater cost.

The proposed Heads link

Sydney's Harbour Bridge

LIFESPAN: CHRONOLOG

Prehistory: The earliest bridges were formed when tree trunks were placed side by side over small streams and ravines. An advance on these simple beam bridges was the placing of stone slabs on rock supports to produce clapper bridges. Many clapper bridges, such as the Tarr Steps over the River Barle in England, remain today but cannot be accurately dated.

Another basic bridge form, the suspension bridge, has been used in China and South America for more than 2000 years. Forty thousand years ago, Neanderthal people burrowed underground at Bomvu Ridge in Swaziland. Using bare hands, bones and sharp stones they tunnelled searching for hematite, a stone used for decoration and burial rites.

V&A

Sketch by Verantius, 1617

3200 BC: The construction of the arch is mastered by the Sumerians.

2650 BC: Earliest recorded reference to a bridge. The material or design of the structure, across the Nile, is not known.

2000 BC: Probably the earliest tunnel used for travel was a link under the Euphrates River. The tunnel between the main buildings of Babylon's Royal Palace was constructed by thousands of slaves using the cut and cover method. During the dry season, the river was diverted and a trench dug. After lining the trench with bricks and constructing an arched roof, the trench was then refilled.

850 BC: Construction of the oldest surviving dateable bridge, a stone single-arch bridge over the River Meles in Smyrna (now Izmir), Turkey.

179 BC: The Romans build the first stone bridge across the Tiber. One stone arch of the Pons Aemilius is all that remains, but there are many magnificent Roman bridges and aqueducts, such as the Pont du Gard, Nimes (AD 14), still standing.

6th Century AD: The Shogun's Bridge in Nikko, Japan uses the principle of cantilevering.

1209: London Bridge is completed. Begun in 1176 by Benedictine monk Peter of Colechurch, it consisted of 20 narrow stone arches and was lined with shops and houses for almost its entire length. It was replaced in 1831.

1335: The Ponte di Castel Vechio, a beautiful fortified bridge, is built in Verona. The importance of bridges as transport links meant that they have often been fortified and heavily defended during war. This bridge has ornate battlements along its length and defensive towers at either end. The defences were of no use in World War II, but the bridge was still important enough to be destroyed. It has since been rebuilt.

1345: The Ponte Vecchio is built in Florence by Taddeo Gaddi. It is the most important surviving example of the pont-maison, the building-bridge of medieval times, where houses up to five storeys high were built on bridges.

1550: Sketches by Italian architect Andrea Palladio show a number of bridges using various forms of truss designs. There is not another example of trusses being used until 1758 when Ulric Grubenmann, a Swiss carpenter, builds a 50-metre wooden truss bridge over the Rhine.

1595: Venice's Bridge of Sighs is constructed. Ornate iron bars cover the windows of the bridge that linked the Doge's palace with his prison and torture chambers.

1617: The Venetian engineer Verantius sketches a bridge which is a combination of cable-stayed and suspension bridge using iron chains for support.

V&A

Sunshine Skyway Bridge

1802: Albert Mathieu displays his plans for a tunnel under the English Channel. The proposal includes an artificial island midway where horses can be changed.

1810: Thomas Telford builds the 46-metre span cast iron arch of the Bonar Bridge over the Dornoch Firth in Scotland. Telford was the founding president of the world's first civil engineering society.

1824: The development of modern Portland Cement around this period is normally attributed to Aspdin.

1825: The oldest bridge still standing in Australia, the stone arched Richmond Bridge in Tasmania, is completed.

1826: Telford's Menai Bridge over the Menai Straits in Wales has the world's then longest span at 177 metres. The wrought iron, chain-suspension bridge is the first to span an open stretch of ocean and reflects the emergence of the suspension bridge as a modern form capable of producing the longest spans.

1828: At the age of 22, Isambard Kingdom Brunel is seriously injured while working on the tunnel his father, Marc Isambard Brunel, is constructing under the Thames. Marc Brunel had patented the Brunel Shield in 1818, a revolutionary system where a large iron collar was used to protect tunnellers working at the face of a tunnel in soft ground. The young Brunel is sent to Clifton near Bristol, to recuperate. In 1829 there is a competition to design a bridge to span the nearby Avon Gorge. Though Brunel had no bridge-building experience, his design for a suspension bridge is accepted in 1831, but his masterpiece is not completed until 1864, five years after his death.

1840: American Earl Trumble is credited with building the first iron truss bridge over the Erie Canal, New York State. Another American, Squire Whipple, used the first all-iron truss of "modern" form 13 years later. Iron and steel truss forms remain popular for short-span railway bridges until the development of 20th century concrete technology.

1850: Robert Stephenson's Britannia Bridge is built over the Menai Straits in Wales. Like Brunel,

AUSTRALIAN INTERNATIONAL

Brooklyn Bridge

Stephenson was the son of a famous engineer. George Stephenson had designed the world's first successful steam railway in 1825.

The Britannia Bridge is made of stiff square-section wrought iron tubes in two main spans of 140 metres each. It was originally planned to be a suspension bridge, but tests show that the tubes were strong enough to stand on their own.

1855: John Anderson Roebling spans the Niagara River with a 250-metre iron wire rope suspension bridge. It is the first major suspension bridge to carry a railroad for any extended period. Passengers have plenty of time to enjoy the view because trains are limited to 3 mph to reduce stresses.

1867: French gardener Joseph Monier patents the idea of strengthening thin concrete vessels by embedding iron wire mesh in the concrete. In 1879 another Frenchman, Francois Hennebique, fireproofs a metal-frame house he is building by covering the iron beams with concrete. These advances lead to the structural system where the metal carries tension-reinforced concrete. Hennebique goes on to build the longest spanning reinforced concrete bridge of the 19th century with a central arch of 50 metres.

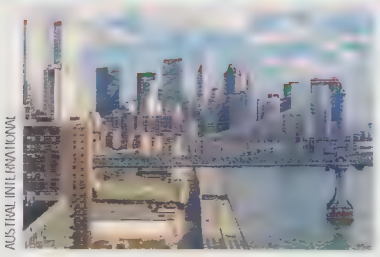
BRITISH RAILWAYS BOARD

Forth Bridge

1779: The Iron Bridge over the Severn River, Coalbrookdale, England is designed by Abraham Darby III. This is the first major structure built of iron.

1794: The first recorded Australian bridge is built in Parramatta. Australia's first stone bridge was built across the Tank Stream in 1804.

F BRIDGE BUILDING



AUSTRIAN INTELLIGENCE OFFICE

Manhattan Bridge

1874: James B. Eads bridges the Mississippi at St.Louis with the first major structure made of steel. Its 150-metre arches were the longest in the world and provided a transport link the city needed to compete with Chicago for economic dominance of the midwest.

1877: Gustave Eiffel's Pia Maria Bridge over the Douro River, Oporto, Portugal, is opened. Its 160-metre crescent-shaped arch of wrought iron was both beautiful and economical, its cost being 31 per cent lower than the next bidder.

1883: The Brooklyn Bridge over the New York's East River is opened. By that time, its construction had claimed over 20 lives including that of its designer, John A Roebling.

1890: The Forth Bridge over the Firth of Forth, designed by Benjamin Baker, is opened. Its two steel cantilever truss spans are each 521 metres, the longest of their time. Originally the Firth was to be bridged by Thomas Bouch but the public lost confidence in him when his Firth of Tay bridge collapsed as a passenger train passed over it in 1879.

SWISS NATIONAL TOURIST OFFICE

Ganter Bridge

1911: Frenchman Eugene Freyssinet observes that the concrete arches of the Le Veudre Bridge he had built over the Allier river, near Vichy, France had begun to sag. Freyssinet inserts jacks into the crowns of the bridge's arches and forces the halves apart to raise the arches and filled the gaps with concrete – a form of prestressing. In 1928 he went on to patent a more general concept of prestressing, where steel cables force concrete into permanent compression. In 1946 he built the Luzancy bridge over the Marne River in France, first to show the possibilities of concrete-beam bridges when compressed by large forces induced by high-strength steel tendons within the structure.

1917: The Quebec Bridge over the St Lawrence River, Canada, opens. It still has the longest cantilever truss span in the world, 549 metres. Part of the bridge collapses during construction and by the time it opens, 87 workers are dead.

1930: The Salginatobel Bridge near Schiers, Switzerland is opened. Its designer, Robert Maillart, is considered by many to have produced the most innovative and beautiful bridges of the 20th century. The Salgintobel arch, with a 90-metre span, is far from the largest of its time but, like his later Schwandbach Bridge, its revolutionary form and economy of materials is acclaimed.

1931: Othmar Ammann's George Washington Bridge over the Hudson River in New York is opened. The 1070-metre span of this steel suspension bridge was almost twice the span of any existing bridge. By the 1930s road transportation has replaced rail as the dominant transport technology. Freed of the need to service a rail route, the designer of the George Washington Bridge is able to select a location where the geology best suits the design. The bridge could also carry the lighter "live load" of vehicular traffic rather than the massive weight of trains.

1932: Work begins on the Golden Gate Bridge spanning the entrance to San Francisco Harbour. On completion, its span of 1280 metres is the greatest in the world. Its spectacular location and the Art Deco elegance of its 230-metre towers make it one of the world's most admired structures, but it is not a true breakthrough in bridge design. In March, during the opening of the Sydney Harbour Bridge, Jack Lang, the Premier of NSW, is upstaged when a mounted member of the right-wing New Guard slashes the official ribbon with his sword.

1940: The Tacoma Narrows suspension bridge in Washington State collapses. Winds caused undulations and four months after opening, a 40-knot gale turns the up-and-down dance into a wild twist. After the bridge collapses, many other bridges have their decks strengthened.

1950: The Lahn Bridge at Balduistein, West Germany, is the first prestressed concrete bridge to be made using the free cantilevering method where the bridge is built out from its pylons without any temporary formwork as support.

Free cantilevering had long been a popular method of building steel bridges but neither simple nor reinforced concrete had been well suited to the stresses that arise during this form of construction. It required a clear understanding of the qualities of prestressed concrete for this method to become a popular form of bridge construction.

1955: The Stromsund Bridge in Sweden is built. It is widely accepted as the first of the modern cable-stayed bridges made possible by the development of high-strength steel for the cables. Melbourne's Westgate and Sydney's Glebe Island bridge are developments on this theme.

VSL

Gateway Bridge

1957: Bridge on the River Kwai, which tells the story of PoWs being forced to build a bridge for the Japanese, wins seven Academy Awards.

1962: The first prestressed concrete bridge using the incremental launching method is built over the Rio Caroni in Venezuela.

1964: The Gladesville Bridge across the Parramatta River near Sydney is opened. Its concrete arch, spanning 304 metres, was for some time the largest in the world.

1969: The world's longest bridging, the Second Lake Pontchartrain Causeway, is completed near New Orleans. The 38.4 kilometre long structure requires no long spans and like the nearby first causeway, which sits on 2215 bents, its construction is more an achievement of the mass production of precast prestressed concrete than the bridge builder's art.

1970: Melbourne's Westgate Bridge collapses on October 15 during construction. Thirty-five people die. The collapse occures during atempts to remove a buckle from a section of steel box-girder decking. The Royal Commission highlights "mistakes, miscalculations, errors of judgement, failure of communication and sheer inefficiency."

VSL

Kemijoki Bridge

1975: On January 5, the freighter Illawarra slams into a pylon of the Tasman Bridge in Hobart. The designers had planned for just such an impact, and only the section supported by that pillar collapses. But a concrete roadway section does crash, and the ship sinks with the loss of seven crew. Five bodies are recovered from cars that plunge into the river. Nine years later, the Bowen Bridge opens upstream, away from shipping lanes.

1977: The New River Gorge Bridge, West Virginia, becomes the world's longest steel arch bridge, a record it still holds. Its span of 518 metres is 15 metres longer than the Sydney Harbour Bridge but its deck not as high.

1980: Christian Menn's Ganter Bridge on the Simplon road, above Brig in Switzerland is opened. The encasing of the bridge's cable-stays in concrete give it a striking new look, acclaimed by many as the most beautiful bridge built since World War II.

1981: The Queen opens the Humber Estuary Bridge. Its main span of 1410 metres is the world's longest. The bridge's 162-metre towers are 36mm out of parallel to allow for the curvature of the earth. The Akashi-Kaikyo bridge linking the Honshu and Shikoku islands of Japan is to be completed in 1998. Its central span of 1990 metres will be the world's longest.

Golden Gate Bridge

1986: The Gateway Bridge, Brisbane is opened. Its central span is 260 metres.

1988: Construction of the Sydney Harbour Tunnel begins.

1989: The California earthquake causes minor damage to San Francisco's Bay Bridge when one of its approach spans collapses, but there is no serious damage to the Golden Gate Bridge.

1991: French and English tunnellers have regular contact after a section of the Channel Tunnel's service tunnels meet.

THE GREEN GAU

The attempts to set the environmental agenda for the next century are elaborate and complicated. Many layers of policy making are essential, and they must be made to work. Think globally, act locally remains an effective formula

BY ROSS PEAKE

We know that the planet is threatened and that this fragile continent has been mistreated. The question now, for you, me and the policy makers, is how to find a sustainable future, a world with enough resources for our children. Many governments are moving towards that goal. The Federal Government has taken a giant step, establishing an ecologically-sustainable development process. If you've been to one of the all-day forums held around the country in the past few months, you will have heard the message about our future.

The ESD initiative is one part of the elaborate development of green policies: there are also parliamentary inquiries, the Resource Assessment Commission, the Bureau of Rural Resources, the CSIRO, recycling strategies and community groups, all trying to steer us towards a green future. A powerful message is that we should aim to leave the world for our children as good as, but preferably better than, we found it. The world is our inheritance, held in trust for those who follow.

This theme was highlighted by the World Commission on Environment and Development. Its 1987 report, *Our Common Future* (The Australian edition of *Our Common Future* was sponsored and introduced by the Commission for the Future) called for a global push towards sustainability. Some conservationists dispute the need for economic growth as part of that goal. In 1989 the Prime Minister, Mr

GLOBAL

World Commission on Environment and Development, known as the Brundtland Commission, published *Our Common Future* in 1987, proposing the long-term environmental strategies for achieving sustainable development.

UN Conference on Environment and Development, to implement the Brundtland report, holding international conference in Brazil in June 1992.

World Conservation Union assesses and approves proposals for the World Heritage List.

International Tropical Timber Organisation, formulated action plan to reduce destruction of tropical forests.

South Pacific Forum: priority a nuclear free Pacific.

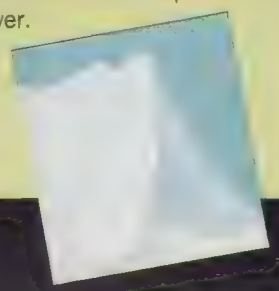
Toronto international conference in 1988, set targets for reduction of Greenhouse gasses.

Bergen (Norway) international conference in 1990 on how industrial countries could implement Brundtland recommendations.

South Pacific regional environment program, examining issues including driftnet fishing, chemical dump on Johnson atoll.

Antarctica: Australia and France lead push for a mining ban.

Many countries are **reducing production of Greenhouse gasses and CFCs** which deplete the ozone layer.



NTLET

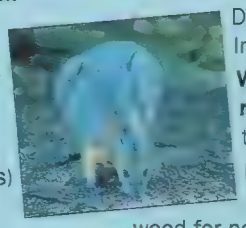
FEDERAL

Groups/organisations:

Prime Minister's round table, brings together industry, unions, conservationists.

Ecologically sustainable development working groups, writing policies for fisheries, forestry, agriculture, energy, mining, transport, manufacturing, tourism.

Federal environment protection agency, operating by end of the year, will frame national guidelines, for example, on air and water quality.



ANZEC (Australia and New Zealand environment ministers) and **Concom** (nature conservation ministers) develop national policies.

Resource Assessment Commission, has reported on Coronation Hill and forestry; examining coastal zone.

Australian Heritage Commission, administers National Estate register.

Parliamentary inquiries; reported on coastal zone and impact of Greenhouse effect.

Industry Commission: inquiries into rail, mining industry, energy generation and distribution, recycling; examining economic cost of Greenhouse targets.

Policy/action:

Our Country, Our Future: in July 1989 the Prime Minister, Mr Hawke, calls for planting one billion trees.

Ecologically sustainable development discussion paper, issued June 1990, in response to the Brundtland Report (one of commitments from PM's round table.)

Intergovernment agreement on the environment, expected to be ratified by the special Premiers conference, aims for co-operative national approach.

National forest inventory and national forest policy, being developed by Department of Primary Industries and Energy.

Waste minimisation and recycling strategy, released this year.

Resource security legislation, to guarantee wood for new pulp mills: contested by conservationists.

Nominations for **World Heritage.**

Push for **mining ban in Antarctica.**

Setting targets for **Greenhouse gas reduction.**

Proposed **endangered species legislation.**

National wilderness inventory (Environment Department).

Others:

Ambassador for the Environment, Sir Ninian Stephen, promotes environmental concern.

Data bases: **Environmental Resources and information Network** (Australian National Parks and Wildlife Service.)

STATE

Special Premiers conference, framing agreement to produce co-operative national approach to the environment.

State environmental protection agencies, monitoring state of the environment, writing guidelines.

National parks and wildlife departments and soil conservation services: programs to protect the environment.

Parliamentary inquiries, eg in NSW on development of the coastline.

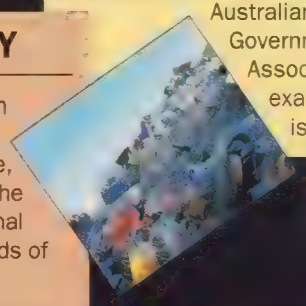
Agreements for protection and logging of sections of forests.

Representatives work on **ESD groups.**

LOCAL GOVERNMENT

Recycling strategies to collect household waste, implemented by many councils.

Environment round table, run by Australian Local Government Association, to examine issues.



COMMUNITY

Green movement: eg, Australian Conservation Foundation, Wilderness Society, Greenpeace, World Wildlife Fund, Friends of the Earth, Greening Australia, regional conservation councils. Thousands of people involved.

Input into ESD groups, particularly in ESD forums.

Farmers active in Landcare, run by Australian Conservation Foundation and National Farmers Federation to reduce soil erosion.

Take part in **Clean Up Australia day.**

Recycling household waste: paper, bottles, plastic, aluminium cans.

Greening Australia: revegetation program including the target of planting one billion trees.

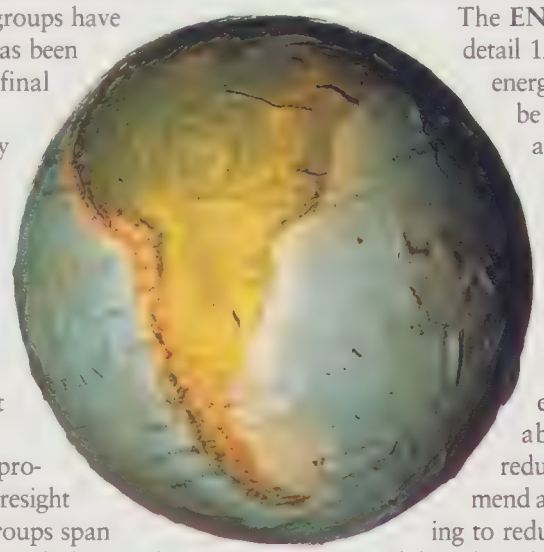
"A better future is something the next generation will see"

Hawke, put Australia on notice in his statement, Our Country, Our Future. It's mainly remembered for the goal of planting a billion trees, scoffed at then but now expected to be reached in 1994.

The Federal Government responded to the Brundtland Commission's report in June last year with an ESD discussion paper. From that, positive action is flowing: nine groups, established by the government, are examining how to put industry on a sustainable basis. This is an ambitious plan and will mean some pain, but Mr Hawke has told the groups he wants concrete results.

They will strike problems in changing attitudes and practices. For instance, will it require an end to growing crops or grazing stock or ravaged land? Does reducing Greenhouse gas emissions mean restricting the use of petrol-engined cars? And what about setting pollution standards for industry which could push up the price of everyday supermarket items?

There are major political problems ahead, with no certainty the reports will be implemented. The groups comprise people with diametrically-opposed views. It's hard to see miners and greens reaching agreement. Officials say the groups have been surprised how much common ground has been found, but the crunch will come when the final reports are due.



The groups have to carry the community with them on the "road to greenness." People can see results from recycling, with recycled writing paper on the market, but it's harder to say if there is a long-term view, such as a community consensus on bearing the costs and sharing them equitably. A better future is something the next generation will see, but we have to pay the price now, and that cost could be lower living standards for all.

And there's the problem of political compromise. Will politicians have the guts and the foresight to make the tough decisions? The working groups span the gamut of resource-based industries and include a wide range of experts, from government, industry, unions, and community and conservation groups.

They are examining agriculture, fisheries, manufacturing, mining, energy production, energy use, transport, tourism and forestry. The task of the groups is to provide advice to the government on future policy directions and to develop practical proposals to implement them.

The reports set out where we are now and where we need to be to achieve sustainability. Each report nominates the key issues, offering practical policy approaches and identifying as accurately as possible what costs are to be faced. The themes of the work emerged at the second mass gathering in foggy Canberra in late June. The meeting examined issues which did not fall neatly into the ambit of any group, such as population, intergenerational equity and urban planning.

The director of the CSIRO Institute of National Resources and Environment, Dr Roy Green, has responsibility for agriculture, fisheries and forest use. Professor Stuart Harris, of the Department of International Relations in the Research School of Pacific Studies at the Australian National University, leads the energy production, manufacturing and mining groups. The energy use, tourism and transport groups are chaired by the professor of economics at Macquarie University, Professor David Throsby.

While all this is happening, a complex web of other activities is occurring, although some are little noticed. The Resource Assessment Commission was set up as an expert body to examine development-versus-environment disputes. It reported on the proposed Coronation Hill mine in Kakadu National Park, and is currently examining forests. Terms of reference are being finalised for an inquiry into the coastal zone.

The special Premiers conference last October drew up a statement on the environment, which will provide a co-operative national approach to the environment. This should reduce the number of environmental disputes between governments, provide greater certainty in government and business decision-making and give better environmental protection.

Senior government officials say the fine print is being worked over by a team of federal and state officials. They hope the next special Premiers conference, in November, can conclude an agreement on the environment, but admit they are battling to resolve difficult issues. For instance, will Australia lose trade competitiveness if industry is forced to cut back Greenhouse gas emissions faster than in other countries? The issue here is the cost of leading the way. What is not yet clear is the gaps in the research: what should we be looking at first, before inquiries charge off? With the ESD working groups drafting their reports, let us look in more detail at the issues they're grappling:

The **FORESTRY** group is grappling with the fundamental issues of land allocation and acceptable levels of loss of biodiversity. The group generally believes that forestry activity has less impact on biodiversity than other forms of land use such as agriculture.

The **ENERGY USE** group has been examining in detail 12 areas offering the greater scope for saving energy. The chairman has suggested change could be affected by pricing, regulation, information and education. Conservationists want this package of instruments to include incentives. They say the fundamental reliance on natural resources and the lack of extensive recycling practices must be addressed.

The **TRANSPORT** group is focussing on reducing greenhouse gas emissions. While the members generally accept the emissions must be reduced, there is scepticism about reaching the target of a 20 per cent reduction by 2005. The draft report will recommend a medium density mix of workplace and housing to reduce car usage, and recommend higher use of rail, bicycle and walking.

The main topic in the **ENERGY PRODUCTION** group is also reducing a carbon tax. The Greens want a levy to raise funds for Greenhouse research. The group has debated the role of research and development of alternative energy sources. The **TOURISM** group wants regional planning to be the method of deciding which areas are to be developed for tourism. One problem is expected to be getting co-operations between local councils.

The **AGRICULTURE** group is grappling with issues such as water quality and competition for land use from urban encroachment. Conservationists believe controls on clearing land are inadequate, and there is disagreement over whether farmers should be compensated for maintaining patches of native vegetation on their land.

Land access is the overriding concern for the **MINING** group. The mining industry has been pushing for access to national parks and favours direct negotiation with traditional landowners rather than going through land councils. The **FISHERIES** group has examined waste and chemical disposal, and the difference between single-system management, which considers the ecological viability of the fishery as a whole.

The **MANUFACTURING** group has discussed closed-cycle production in which all waste is treated and re-used. But it appears that specific recommendations on national guidelines for water, air and noise emissions may not be made before the draft reports are released.

As the path becomes clearer, the major questions to be resolved are overcoming the political obstacles and being prepared to pay the price. The ESD process shows we are able to face the issues, and we are taking the first steps towards a sustainable future. But the bottom line is, are we willing?

Ross Peake is on the staff of the Canberra bureau of The Age.

Revolution puts disease in retreat

Australians are at the forefront of the new therapeutics, but pursuit of the answers to disease requires dedication and funding.

Ever since Paul Ehrlich introduced the first organic arsenical to combat syphilis in 1906, the search has been on for new, more powerful and preferably oral drugs for the treatment of disease. A vast pharmaceutical industry has grown up which is highly profitable, and can therefore afford to spend billions in further research and development. Mostly, the pharmaceutical industry relies on synthetic organic chemistry to produce novel compounds, and on simplified models of disease processes on which to test the new compounds. This drug screening approach is not devoid of intelligent ideas but it retains more empiricism than most basic scientists find attractive.

GUSTAV NOSSAL

There is also a second tradition in therapeutics based on biologicals. In contrast to synthetic drugs, biologicals are substances or materials derived by extracting very active molecules from cells and tissues. For example, insulin – the substance extracted from pancreas glands that has saved the lives of so many diabetics – is a biological. Penicillin is a biological, a natural anti-bacterial substance extracted from the Penicillium mould. Vaccines are among the most important biologicals and represent cost-effective tools in disease prevention.

Perhaps the most important trend in therapeutic medicine in the past 15 years has been the capacity to use genetic engineering technology to mass produce a range of biologicals that were difficult and expensive to extract from natural resources or simply could not feasibly have been extracted at any cost. Recombinant DNA technology has given us a robust, harmless production method for precious proteins. Equally important, it has deepened our knowledge of bodily processes and vastly expanded the range of substances with therapeutic potential. A sub-branch of the pharmaceutical industry has grown up which we may loosely term the DNA industry. It is characterised by small and medium-sized venture capital-based firms which, on the whole, have been able to attract some of the brightest minds in biomedical science.

Examples of the fruits of this new therapeutics include the recombinant hepatitis B vaccine (of enormous importance in developing countries); clotting factors for the treatment of haemophilia (which avoid any possibility of contamination by blood-borne viruses); TPA or tissue plasminigen activator, for the dissolving of thrombi after a heart attack or other vascular accident; and human growth hormone, which could be extracted from human pituitary glands at vast expense and in limited quantities, but which is now available to treat dwarfism and perhaps other conditions. There is enormous interest in early hints that regular injections of growth hormone may greatly enhance physical performance and sense of well-being in aged individuals. There is also a bewildering array of other biologicals being tested as potential anti-cancer agents.

In the future, I believe that these two great traditions of therapeutic medicine – the synthesis of small organic chemicals, and the deep knowledge-based concepts about biologicals coming from recombinant DNA technology – will combine into an even "smarter" science. Very advanced techniques of protein chemistry, such as X-ray crystallography and nuclear magnetic resonance spectroscopy, are revealing the structure of proteins at atomic levels of resolution. It becomes possible to build models of proteins that are as detailed as the models of the human body which the early anatomists obtained.

Based on this knowledge, organic chemists, aided by advanced computer technology, can now design drugs to strengthen or weaken the function of the protein of interest as the particular disease situation demands. This coming together of molecular biology, protein chemistry, computer technology and organic chemistry is at the very leading edge of modern biomedical science. It is, incidentally, also the strategy on which the new Co-operative Centre on Cellular Growth Factors depends. This centre embraces the Walter and Eliza Hall Institute, the Ludwig Institute for Cancer Research, the Biomolecular Research Institute, the CSIRO Division of Biomolecular Engineering and the AMRAD Corporation as the commercialising partner.

Until about a decade ago, most Australian researchers acted on the assumption that their debt to society was repaid by doing the research, publishing it in the open literature and hoping that someone, somewhere, would build on the discovery to produce a new therapeutic. We are now learning fast that this approach is not enough, and that both the economic progress of the country and the optimal development of discoveries for the sake of humanity demand a more aggressive commercial posture.

One of the problems is that the pharmaceutical industry is dominated by large and powerful multi-national firms based overseas, frequently in the US, Switzerland or Britain. These companies choose to do the vast bulk of their research at large facilities in their home countries. They are mostly reluctant to give equity participation in the fruits of new discoveries to any other party.

It will not be easy to get a research-based pharmaceutical industry off the ground in Australia, but there are some promising starts. Firms like AMRAD Corporation Ltd, Biotechnology Australia Pty Ltd or the Commonwealth Serum Laboratories have good leads, clear strategies and plenty of potential. It will probably be necessary to base our industrialisation for indigenous research on skillfully arranged strategic alliances with multinationals, because it will be a long time before any one Australian company is strong enough and large enough to "go it alone" in a world marketplace. We are on a fast learning curve as far as business development of Australian academic biomedical research is concerned, but now that all the major players are focussing on the issue, the medium to long term future does look bright.

Professor Sir Gustav Nossal is director of the Walter and Eliza Hall Institute of Medical Research.

The univer

The scientific quest for the perfect T-shirt slogan is one way of describing the life of physicist Paul Davies. In the 21•C Interview, he tells Terry Lane that religion, creativity, the Big Bang and Margaret Thatcher all play a part.

PAUL DAVIES quotes Einstein on the title page of his book *God and the New Physics*. "Religion without science is blind. Science without religion is lame." This aphorism neatly summarises Davies' own quest for meaning and purpose in the universe through the disciplined inquiries of physics.

Paul Davies is professor of mathematical physics at Adelaide University. Before coming to Adelaide in 1990 "to escape from Margaret Thatcher" he was professor of theoretical physics in the University of Newcastle upon Tyne in England. His special area of interest is in the esoteric field of quantum gravity and he is the author of a number of physics textbooks. But his international popular fame rests on his books like *Superforce*, *God and the New Physics* and *The Cosmic Blueprint*. Next year he expects to publish *The Mind of God*. In these books Davies explores the idea that "there is something going on in the universe." He puts the ultimate question for science like this:

"Was our universe created in a very special state, carefully fashioned so that in the fullness of time, life and eventually mind would blossom forth to marvel at it? Or do we live amid a monstrous and meaningless accident, a cosmic eruption from nothing, that has occurred purely at random? Surely there can be no more pressing task for today's cosmologist than to tackle that central question of existence." *(God and the New Physics).*

sal explorer

How did you first become interested in science?
I often tell people that I embarked on my scientific career having been presented with a Northern Star Atlas by Margaret Thatcher at the age of 15. I still have it. She used to come to our school, which was in her constituency, for speech day and hand out the prizes. So I got a prize on this occasion. I can more or less trace my interest in astronomy and science to about that time. So, bending the truth a little bit, I can say that Margaret Thatcher despatched me on my career and then didn't do much to further it further down-stream.

In my mid-teens I developed an interest in astronomy, so I felt that at the end of the day I wanted to do something astronomical or cosmological. But more particularly I saw that physics was the key subject to physical science, and therefore I wanted to be a theoretical physicist.

I was thrilled by ideas of particle physics and anti-matter and all these weird and wonderful things that didn't make it into the school syllabus, so I was very anxious and impatient to get on to those exciting topics.

When did the connection between cosmology and quantum physics and questions of origin and purpose arise?
In some ways I feel that in addressing these issues I'm really rediscovering within my own psyche feelings, questions or just gut reactions to things that have lain dormant within me from an early age.

I can certainly remember, even at the age of 15 or 16, discovering the paradox about free will. Having learnt from my physics that the laws of physics were supposed to explain everything, presumably including the motion of the electrons in our brains, it seemed to me that everything should be determined so that there would be no room for free will. I can remember asking the local vicar what he thought about the problem.

I also came at it from another point of view, which is that we only really do what we want to do, even though sometimes we may say we don't want to do it. What we mean is, we get no pleasure from doing it. But when we make choices, we do so on the basis of some sort of predisposition, and it seemed to me that therefore it was no real choice at all. So, both from the philosophical angle and the physical angle, I began to have difficulties with ideas of free will and determinism.

As to questions of the ultimate origin of the universe – well, I was a student at the time when the Big Bang theory was still not properly established, and the Steady State theory which says there are no ultimate origins of the universe was very popular. I suppose the first time that I ever really was exposed to questions of the origin of the universe in an arresting way was in my first year as a post-graduate student at University College, London, when I went to a course of lectures about astrophysics. The lecturer made a quip about the heat radiation from the Big Bang. Now this heat radiation was discovered by radio astronomers in 1965, and in 1968 when I attended the lectures the discovery was still fairly new, and people were working out the implications.

The radiation was detected as a background hiss of heat radiation which bathes the whole universe, and is widely supposed to be a relic from the heat of the Big Bang itself. The Steady State theory really couldn't explain this radiation in any convincing way, and so it is taken as powerful confirmation that there really was a Big Bang.

But knowing that this heat radiation is there, and knowing what its temperature is, you can then work backwards and reconstruct the history of the early moments of the universe when everything was much hotter. And this was, at the time, quite an industry. People were trying to figure out, in particular, what the hot early universe would be like in terms of the chemical composition of matter. We now pretty well understand that the universe began in a state that was so hot that matter was broken down to its most basic constituents, but as the universe cooled things congealed together, so to speak, to form more complicated substances. In particular, the element helium was synthesised during the first few minutes of this Big Bang. All this stuff was still very tentative in '68, and I can well remember the lecturer making a joke about scientists working out that helium was produced during the first three minutes of the universe. Everybody laughed, because it seemed so ludicrous that one could seriously talk about what happened during the first three minutes of the universe. And yet now this is textbook stuff.

There's always room, of course, for adapting the very simplified picture that we have of a totally uniform gas at a common temperature just consisting of a mixture of protons and neutrons and so on. It may be that there are some complications to that, but the simple picture gets us a long way. But at that time it seemed so audacious that one could actually apply physics to the first few minutes after the creation event that it was considered a bit of a joke.

In one of your books, you say that you think that science provides a surer path to God than religion.
Yes. It was supposed to be deliberately provocative, of course, that phrase. I believe that science is a wonderful thing because it is not terribly obvious, when you stop to think about it, that science should work. That is to say, that human beings should have the intellectual capability of unravelling the secrets of nature. We live in a very complex universe, and it's not at all obvious that the underlying laws or principles should be accessible to human beings. After all, our brains have evolved to have certain capabilities which presumably have nothing whatever to do with understanding the internal structure of the atom, or what goes on inside a black hole, or whatever, and it's still a great mystery to me why it is we're actually capable of doing science. But as we are, it seems a golden gift, and science is so successful in providing a picture of the world that I think it does provide a very sure path.

Science sets uncompromising standards of rigour and objectivity, whereas many other aspects of human inquiry are notoriously subjective or contentious.

Particularly religion.
Particularly religion, of course. And although it's not true that in their daily working lives scientists are totally dispassionate, according to the rules of science there's supposed to be no dogma, and scientists are supposed to readily change their minds if the evidence changes. I think by and large (and certainly in physical science) these high standards are maintained. Therefore I think that scientific knowledge is probably the most reliable knowledge we have.

When it comes to matters of meaning of purpose or deeper issues – the ultimate origin and end of things, or the place of human beings in nature and so on – it's often supposed that science is a depersonalising or dehumanising activity. That is, it marginalises or even trivialises human beings. And it has had a tendency to do that, but in recent years more and more scientists (not only physicists, but astronomers, chemists, biologists) are rediscovering that our existence in the universe is not just a trivial event and that we are not just some incidental by-product of random processes in some remote corner of the universe that has no wider significance, but that our existence in the universe is actually tied in with its basic processes in a very fundamental way.

PICTURES BY DAVID JOHNS

Now, when I say "our existence" I don't mean that homo sapiens as a particular organism is pre-ordained and written into the laws of nature right down to five fingers and toes. But I mean that the general tendency for the universe to evolve or progress from its initial state of almost total featurelessness to an ever richer variety of complex organised systems is written into the laws of nature, and that the emergence of consciousness as a phenomenon is inevitable given the nature of these laws. That is, that this general progression towards greater complexity leading on to consciousness is something which is very deep-seated in the nature of things. And it's interesting to wonder whether, had the laws of nature been slightly different, things would have turned out in quite the same way. So I do believe that our existence, and in particular the existence of consciousness and intelligence, if you like.

"Mind" is the word you use in *God and the New Physics*.
Mind, is, I guess, the better word – and mind is not just some quirky little by-product. Some biologists, of course, intimate that perhaps intelligence is some accident that just happened to be because of certain special conditions that by a total fluke happened to occur on Earth, and that you wouldn't normally expect intelligence to emerge from biology. But I question that. It seems to me it's actually a very basic phenomenon, and if we could rub out the universe and start again something rather similar would have emerged somewhere else at some stage. I don't think that our existence in the universe is a trivial matter.

> I think it is wrong to try to justify doing things like quantum gravity on the basis that we might stumble upon something that perhaps in another hundred years may lead to a gadget that can be marketed and make somebody rich.

On the subject of mind, I can imagine that a biologist who is a rationalist would say that all that mind is really is a collection of memories and instinctual reactions that are necessary for survival, and that in its down-time – when it's idling because it is not needed to run away from sabre tooth tigers, for instance – mind may produce *Hamlet* or *The Magic Flute* or *The Last Supper*, but that's all it is, the eccentric application of a survival mechanism. Now you suggest in *God and the New Physics* that there is more to it than that.
Yes. I'm convinced there's more to it than that, and this is why I love science so much, because it seems to me to be a manifestation of this deeper meaning. It seems to me that the fact that we can do science is not a thing that one could explain on the basis of Darwinian selection.

I like to put it this way: the laws of nature are written in a sort of cosmic code. When we do science in the laboratory, or when we just make simple observations of the world about us, we don't actually see the underlying laws, we see rather complicated behaviour, and we've got to be pretty smart to decode that behaviour. And the fact that we can crack that cosmic code is a truly remarkable thing. It seems to bear no relation whatever to survival in the jungle. Although it's sometimes argued that avoiding falling objects, an ordinary mechanical process that our brains have to be programmed for, bears some superficial relation to Newtonian mechanics. But it's quite clear that's not the way the brain works at all. I mean, animals dodge falling objects as well – sometimes a lot better than us – and they're not doing it by contemplating the nature of the laws. Yet the very fact that in our higher mental processes we can get access to these laws is, to me, truly remarkable.

Mathematics is a product of the higher human intellect, and yet astonishingly it finds such ready application to the most basic processes of nature, including the internal workings of the atom – things which have no relevance whatever to daily life, or to anything else that we can see in our evolutionary history. There's no reason at all why Darwinian evolution should have selected us for this ability.

Consider human development. Think about your education. How long does it take you to learn the mathematics to be able to work out what's going on inside a proton or something about the quarks, or the fate of a Black Hole? You're probably talking about 15 or 20 years of mathematical education.

Now it would be very easy to imagine a world in which it required 50 years, or 500 years, or 5000 years, given that the laws of nature are not transparent at a glance. Why is it that they are such that just a modest amount of attainable education and training will actually enable a human being to access the key to the universe – to unlock the secrets of nature? It looks contrived. It looks as though our lives have somehow been fine-tuned to be able to understand the laws of nature. I'm not saying that the world has been deliberately designed so that we can decode it, or we've been deliberately designed as decoders, or anything quite so contrived. All I'm saying is that I think that there's a link between the existence of mind in the universe and the particular form of the underlying laws. So if there is a purpose behind the universe then we're part of that purpose in a rather intimate way.

There could be another reason why people are apprehensive about science – that is that religion offers an easy insight into meaning on the basis of intuition and wishful thinking. But what you're suggesting is that to have a truly satisfying comprehension of the universe – its origins and its purpose and so on – the rigours of science are inescapable. The only worthwhile belief is based on scientific literacy.
Or at least will emerge through it, or cannot ignore it. There's a lot of debate about whether science can explain everything, for example, or whether science is totally satisfying in its description of the world – whether there are aspects of human life which simply lie outside the scope of science. You think of artistic experience or things like love or patriotism or whatever, human emotions that don't seem to fit too well into the scientific mould. I like to think that there is no particular event that occurs in the universe that could not at some level of detail in principle be explained by science – that is, it would fall within some comprehensive set of laws that wouldn't ever involve interference by an outside agency, anything supernatural or peculiar going on. Of course, one could never really prove that is the case, and when it comes to human consciousness there's layer upon layer of things that we can experience which at the moment lie outside scientific description. But that doesn't mean they can't have them. Nor does it mean that if we describe something scientifically we render it somehow use-

less or irrelevant or explain it away. There's a difference in explaining something and explaining it away.

Most people, I think, feel that science robs the world of its mystery – that once things have been explained it somehow devalues the things that you're describing. I see it as just the opposite. It means you encompass it within this marvellous rich network of laws and principles. We don't know where these laws and principles have come from. All we can say is that they look as if they've been designed. It hangs together so well that I find this truly inspiring.

I remember you saying to me once that it's possible that time, space, matter and the laws of physics were all created simultaneously at the moment of the Big Bang. Now that's existentially terrifying because we simply can't conceive of the Big Bang happening anywhere except inside a volume that we would call "space", even if there's nothing there. And we can't conceive of anything banging that isn't already matter, even if it's infinitesimally small. What's more, we can't conceive of it happening except at a point in time, even if we call that point one.

These are all simply limitations in human imagination. For me the great power and excitement of science is that we can go beyond what we can imagine, and this is particularly true of physics. Because we have mathematics at our disposal we can provide explanations for events and circumstances that are totally outside any ability of human beings to imagine. And when people talk about space, time and matter springing into existence all in one go from nothing, which is the standard picture now, it's very hard to imagine what would that be like. But of course the very notion of happening is not relevant here, because the coming into being of time itself cannot be described as something actually happening. It's the beginning of happenings.

So we are all the time limited by our ability. But you see we are able through our mathematics to unlock the secrets of nature to provide a description of things which are wildly and completely beyond human experience.

We can actually make predictions about things that occur inside atoms that nobody can have any slightest idea of visualising. Never mind the origin of the universe, just even an electron moving around an atom. People quite erroneously think that it's like a little billiard ball going round another billiard ball, and it's nothing like that at all. The electron doesn't even have a place. It can't be pinned down at a location. It's a sort of pattern of vibrating energy with only a sort of probablistic interpretation. It's something totally nebulous and outside human experience, yet we can still make progress with it. We can make actual predictions. We can build machines that actually use these processes.

Your special interest in quantum gravity is so esoteric and so unlikely to lead to the development of a new microwave oven or video recorder that I imagine Mrs. Thatcher would want to take your atlas back. This is the very sort of science that she would consider to be non-utilitarian and indulgent.

That's right, yes.

> In recent years more and more scientists are rediscovering that our existence in the universe is not just a trivial event and that we are not just some incidental byproduct of random processes.

We tend to divide human activity into two groups – what we call cultural, which is music and art and literature – and on the other hand another group, which includes science and business and labour. But I rather suspect that you think that science can be as cultural as writing a symphony.

Absolutely right. I think this schism into two categories is so damaging for intellectual life. It's a schism which is particularly bad in the English-speaking world: one tends not to find this division made quite so starkly in continental Europe, and I suspect not in Asian countries. And if you go back even in English history to the establishment of the Royal Society, back, say, to the seventeenth century, there was no real attempt to divide the sciences and the arts.

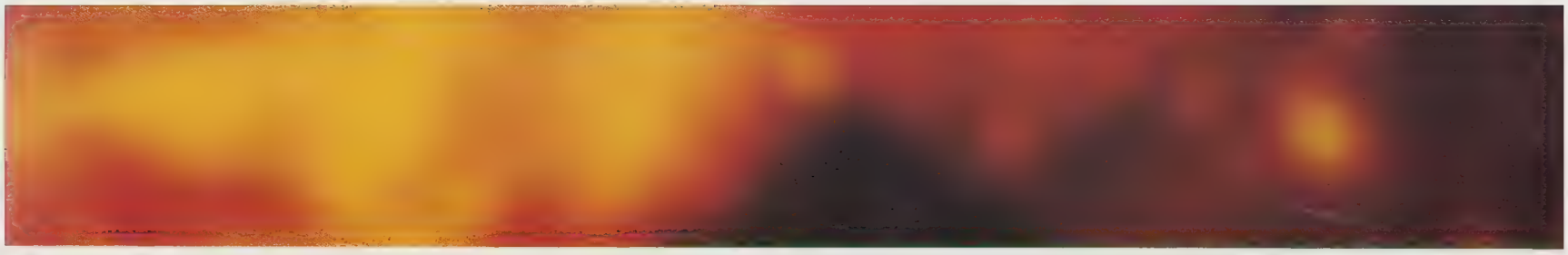
The connection between science and technology really didn't come until the industrial revolution, did it?

That's right. I think probably you can go back and find cases where what we would now call scientists were dragooned into military projects – Archimedes and people like this actually worked on weapons – but it's quite true that the systematic exploitation of science for economic and military purposes is really something that is pretty recent. One might almost say in the case of physics it's something that dates from the Second World War. The Manhattan project and radar for the first time saw large numbers of scientists organised around a particular project with the enormous funding that requires. This type of big goal-oriented science in which lots of scientists would collaborate in an organised manner is something which is really rather recent.

In a way science, particularly physical science, has become a victim of its own success. Because it is able to deliver the goods, people tend to think that the only reason for doing it is for its technological fruits. And there's less and less value attached to doing science for its own sake.

I think it is wrong to try to justify doing things like quantum gravity on the basis that we might stumble upon something that perhaps in another hundred years may lead to a gadget that can be marketed and make somebody rich. I think the reason we're doing science is because human beings need to know about the nature of the world they live in, and they need to know their place within that world.

It does matter to people that we know that the sun is at the centre of the solar system and not the Earth. I think it had a profound effect on human society when it was learnt that the world wasn't at the centre of the universe. And there are many other discoveries that have been made in science – like Darwinian evolution – that have totally transformed the way we see ourselves and the world we live in. And to say that the inquiries into these deep issues will only be justified in terms of somebody being able to make a better microwave oven is a pretty poor show. A society that is too mean-spirited to devote some small fraction of its resources to uncovering the deep issues for their own sake is a society with all sorts of problems. What bothers me is that if you stifle basic research you're really stifling an aspect of human creativity that we can see has been there from the dawn of history. Go right back to ancient Greece and the underpinnings of our whole civilisation and you see this same spark of human creativity.



How close are we to knowing everything that we're ever going to know?

Some of my more enthusiastic colleagues are talking about the end of theoretical physics being in sight and in another 50 years we will be able to write down the formula on our T-shirts that will be the theory of everything. It's very hard to know how seriously to take these things. Certainly most scientists would say that this is just a lot of nonsense, and that science will go on forever, but there's a sort of curious thing if you think about it. Imagine society in another 10,000 years or so. We can't go on making discoveries at the same rate as we are today forever more. At some stage we would have reached the limits of what we either know or need to know and people would just get bored with endless amounts of inquiry just to fill in the last little details. So it seems that science just can't go on forever. It will either just peter out as becoming something less and less exciting, or it will reach a culmination in some way. And I like to believe it will actually reach a culmination.

Now you have to distinguish between two ways of doing science – the reductionist path and the holistic path. Science has been dominated by reductionism for at least 300 and possibly 2500 years. Reductionism is the idea that the complicated world is made up of a lot of simple things put together, and the complicated behaviour is ultimately traceable back to simple rules and principles, and that we will understand these elementary components and principles by distilling things down to their essences, or by breaking matter apart and looking at smaller and smaller constituents. This reductionist path has been very successful. It is quite conceivable, and I think actually quite likely, that within a number of decades we will reach the culmination of this reductionist program. We would actually be able to put in place in mathematical form the underlying laws and principles on which the world is built. That is to say, we will be able to identify the deepest level of reality – the most basic components, whether they're quarks, or something inside the quarks, or whatever. I think we're converging towards the time when some sort of unified theory of the most primitive entities out of which the world is built will be accessible to us. We could actually imagine opening a textbook in which we find the answer to this long quest that was begun two and half thousand years ago.

I don't think that such a theory would tell us how life originated, or why people fall in love, or movements in the stock market. There will be plenty of things which simply cannot be understood in these reductionist terms. So on what we might call the holistic path – looking at the collective and organisational properties of matter – it seems that is probably an open ended thing, because there seems to be no limit to the richness and diversity of physical forms and to ultimately higher and higher organisational levels. We see human beings as probably having reached the highest level of organisation in matter and energy in the universe, but surely we're just a transitory phase to still greater levels of organisation. It seems to me that there will always be some interesting science to do, following that upward rather than the downward path. But physics, of course, has had its success in reductionism, and I can believe that it is a completable science.

We are living in a fascinating time because although we don't know all the answers, physics has matured now to a level where we can sort of see our way through to the end in this reductionist sense.

> Most people, I think, feel that science robs the world of its mystery – that once things have been explained it somehow devalues the things that you're describing.

Imagine that we're having this conversation in 50 years. What will we be talking about?

Well, we might be talking about the great Joe Bloggs who has just put the finishing touches to his theory and the book's been published and it's sold more copies than the Bible, and perhaps it's rather a short book. Maybe it's just a T-shirt!

We have glimpsed, just in this last decade, what a totally unified theory of the forces and particles of nature might be like.The sort of theories that are being developed at the moment may have nothing whatever to do with what might be a correct theory of these things. It may just be a totally blind alley. But nevertheless it's possible to glimpse what such a theory would be like. I imagine that, say, 50 or perhaps 100 years of efforts to formulate such a theory will be about as much as human society will tolerate. I think if it wasn't in place after that sort of length of time, the scientists themselves would become bored or they would try to think about the world in a rather different way.

Perhaps in 50 or 100 years people are going to be talking about the synthetic path. That is, they're going to be much more interested in the magical properties of matter. In particular, materials and systems that have never existed in the world before. Until now, science has basically dealt with things that nature has given us. All the laboratory does is to distil some little aspect of something that is already happening out there in nature anyway. What is now happening in both physical and biological sciences is that we're reaching the stage where we're actually making things that nature has never made. This began about the turn of the century when experimenters achieved temperatures below three degrees absolute. We now know that the heat radiation that bathes our universe is at a temperature of about three degrees, and so there's been nowhere in the universe that's been below three degrees until somebody got down below three degrees at the turn of the century in Holland. And so we're then creating an environment or system that has never existed before in nature.

And now people are beginning to make materials that have never existed before in nature. That is, it is now possible to lay down some sorts of structures atom by atom. It's become known as nano-technology – and you can build things at the molecular level pretty well to order.

In the treatment of diseases, for instance, molecules are actually being designed by looking at the nasty – whether it's the AIDS virus or something – looking at its shape and what it does, and trying to literally construct some sort of molecule that will frustrate it. And so, what we're seeing now is scientists actually creating physical systems or environments that have never existed in nature, and have magical properties.

In some cases it seems as though, particularly if we're talking about complex systems, that the matter or the energy of the system has a will of its own. What we actually are beginning to see is that matter has these magical self-organising qualities. And it seems to me that there's an almost limitless variety of possibilities there of systems that can do magical things. And I think in 50 years this will be the dominant science. You'll hear less and less about what everything is made of at the ultimate level of things, and more and more about putting matter and energy together in novel ways and exploring its new properties – creating totally artificial and totally new systems.

It's the 21st century. The weather forecast is fine: with a controlled atmosphere, it always is. Felicity Wesson has just finished ordering the week's groceries, from the comfort of her kitchen, at the touch of a scanning screen. Now she is off to the bright lights and excitement of her local shopping complex . . .

DAVID JOHNS

COMING SOON TO YOUR NEIGHBOURHOOD... THE SUPERSTORE

Not shopping by home digit-screen today? Drive instead to the superstore of the future, opening soon at your local megacomplex

BY LIBBY LESTER

Gilbert Rochecouste pulls out a piece of paper and firmly draws a triangle. At the base of the triangle, he writes "Shelter and Food". Further up, he writes "Entertainment" and higher still, "Love." At the tip he writes "Self-Actualisation." That, he says, is the Maslow Triangle of Wants and Needs. Chadstone, the huge shopping mall at the geographic heart of Melbourne, where he is marketing manager, began in 1960 by providing basic Wants and Needs. But recently it has been moving up the triangle. Customers, he says, can soon expect to take a step towards Self-Actualisation when they shop at Chadstone.

Fifteen kilometres away, in a building visible from Mr Rochecouste's window, John Hughes is also drawing a triangle: an upside down triangle. Mr Hughes is marketing manager for the Daimaru department store, the main tenant in the new Melbourne Central retailing-entertainment-office complex in the CBD. At the top of his triangle – the broad part – he writes "Service Associates." This is how Daimaru describes its sales people. At the bottom of his triangle – the point – he writes "Chief Executive Officer." Adapting his Japanese company's 270-year-old motto, he says the future of retailing is service: "We might not bow, but we have a service mentality."

Across Australia, as in most countries in the developed world, teams of planners, developers, retailers and marketers are desperately trying to predict the shopper's next whim. They draw hexagons, the sides fitting together neatly to form the perfect nodule city; they produce artists' impressions of neon-lit convenience stores, video-screens on shopping trolleys, computerised catalogues and comparative shopping data bases; they speak of plastic card swipe machines allowing human service to become "discreet"; they describe the home-shopping experience, rows of canned and packaged foods passing across a computer screen, reaching out and softly touching the items to be delivered.

They shake their heads sadly at the mention of strip-shopping centres, milk bars and grocers. But they say reassuringly that there will be room – perhaps a corner, or even a wing – for nostalgia. Most talk in terms of square metres, all talk of competition. The images they invoke can be pleasurable: quality and service; a return to the village market idea of the Middle Ages; home delivery, entertainment and childcare; freshness, convenience, speed and informed choices.

Alternatively, the picture they draw can be bleak: uniformity of place and product; chain-produced notions of community; service provided by machines, not people; erosion


AUSTRAL INTERNATIONAL

Indoor swimming pool, Edmonton Mall

of a unique local, even national identity; further isolation for the single family unit or the alienated aged in their self-contained homes.

But they say consumer demand is dictating the direction they take. The future, they say, depends on what and where we buy now. From fridges to shoes to breakfast cereals, the average Australian household buys one and a half to two tonnes of goods each year. In terms of quantity, this is unlikely to change.

But how we buy has changed. Supermarkets, which accounted for 80 per cent of all food expenditure in 1960, now account for only a half.

Since 1960, fully enclosed regional shopping centres have emerged to control 20 per cent of retail trade in Australia. For example, Melbourne's six largest suburban shopping centres have increased their floor space by 37 per cent in the past five years. One-third of the city's 3.5 million residents visit one of these six malls each week, yet the central business district's share of the retail dollar has fallen from 28 per cent in 1957 to 6.6 per cent in 1989.

Convenience stores, unknown in Australia before 1980, are now scattered liberally across the country with an average of $20,000 a week spent at each of the 360 stores. Only three per cent of Australia's 8000 service stations have convenience stores attached. But in the US, which is dictating the trend, the figure is 60 per cent.

Franchises account for only four per cent of business in Australia. But if the trend continues, in 50 years they could account for 60 per cent. In comparison, small neighbourhood shopping centres are suffering. Considered the "least likely to succeed", they have an average vacancy rate of 20 per cent.

Home shopping in Australia now accounts for only two to three per cent of all retailing and it is predicted that this will rise to about 10 per cent by 1999. Goods worth $25 billion will be ordered by phone, mail or computer in that year. While home shopping has not grown at the rate originally predicted, several long-term changes are expected to make it more viable in the future, including the ageing and thus decreasing mobility of the population, the service's expansion to incorporate more well-known and trusted brand name items, and the installation of fibre optic cables to many homes by the end of the decade.

While critics argue that either it will not work because it ignores the social function of shopping or will work and create a generation of recluses, more than 50 per cent of people have participated in home shopping in the US, buying goods from groceries to real estate.

Our relationship with cars partially explains these trends. Despite growing environmental consciousness, almost half of all households in Sydney and Melbourne own two or more cars. But cars do not explain all our behavioural changes. For example, we spend less time in supermarkets but more time in malls. If Australia continues to follow overseas trends, supermarkets will be filled with technology to allow us to scan our items as we take them off the shelves, and fax through orders or do it all from home on a computer. At the same time, huge shopping malls will be built with fun parks and hotels attached so we can stay inside a complex all weekend.

Domestic air flights will incorporate "Skymall" so we can order items during those wasted hours in the air and collect them as soon as we land. But shopping centres will run numerous and lengthy "how-to" courses. We will be able to find a skirt electronically in the right style, size and colour without leaving home, yet arias will be performed by visiting tenors to draw us to department stores.

Phil Ruthven, executive chairman of the information and forecasting company The IBIS Group, says that we are differentiating more between the various types of shopping. The onerous, regular shopping tasks, such as getting the groceries, will become quicker and more convenient, while we will spend more time on the enjoyable shopping expeditions, buying delicatessen delights and fashion. David Mattingly, chairman of Mattingly and Partners advertising agency, calls it the difference between "doing the shopping" and "going shopping."

Environmental planner Nigel Flannigan says the old cliche has changed. No longer is it one-stop shopping, but one-stop living. "For example, if we go the same way as the US, the big malls will include chapels so people can come on a Sunday morning to worship then go shopping, or the elderly

AUSTRALIA'S TOP SHOPPING CENTRES
(based on number of shoppers per week)

1. Myer Centre, Brisbane	400,000
2. Highpoint City, Melbourne	300,000
3. Chadstone, Melbourne	280,000
4. Northland, Melbourne	260,000
5. Pacific Fair, Gold Coast	250,000
6. Westfield, Sydney	240,000
7. Garden City, Perth	233,000
8. Westpoint Marketown, Sydney	220,000

Figures supplied by centres

will go to the malls for a powerwalking class because they don't feel safe around their own neighbourhood, have a shower and go shopping. "It is life in a controlled environment. People feel safe and warm inside. Undesirables are kept out, only desirables are kept in."

In Brisbane's Myer centre, the first Australian mall to include a fully-enclosed fun park, 400,000 people shop a week. Mr Flannigan says that although it is attracting people back into the city centre, it could unwittingly have a sinister effect on city life. "There are no Hare Krishnas in malls," he says. "No beggars, no op shops, no nasty discount stores. They are all outside, and if the trends continue, they may be the only things left outside. Shoppers are in an enclosed, patrolled environment and therefore the malls could be used as a control mechanism – as beautiful as Camelot all year round. Jerry Falwell of Moral Majority owns a mall in the US. Religion, consumerism, entertainment."

Bernard McNamara, town planner with the Gandel Group, one of the largest owners of shopping malls in Australia, agrees that to capture the "going shopping" market, the function of malls has moved beyond just shopping. Terms like "convenience" and "one-stop shopping" have been replaced by "ambience", "sense of community", "self-actualisation." But rather than being sinister, he says malls are no longer simply responding to consumer demand for products. They are also responding to demand for entertainment, information, education and community awareness.

If suburban shopping malls have identified a need for a sense of community, it is a yearning which they have helped create. Urban planner Dr Jeff Wolinski says that many strip shopping centres were left to deteriorate following the emergence of the malls. But he believes that some can recapture a market share and have a bright future. For some, it will simply be demographics. Surrounded by an ageing population unwilling to drive and unsatisfied by the noisy, crowded malls, they will become a haven filled with remembered shops and faces, familiar habits and products. For others, it will be a result of their unique store mix. For many, however, it will require calculated moves.

Supermarkets are also recognising that they must become more community aware. According to Bruce Bevan, executive director of the Australian Supermarket Institute, supermarkets will not only move the emphasis to fresh produce and healthy, attractive ready-to-serve foods but will become a greater source of information for the public. "Environmental issues, health and nutrition, customers are wanting more and more information from the source," he says.

Why the desire for more information and community involvement from our retailers, even a willingness to allow suburban shopping mall management to talk about our "self-actualisation"? Gilbert Rochecouste, of Chadstone, says the community is suffering from an information vacuum. Education has become a luxury, a leisure activity.

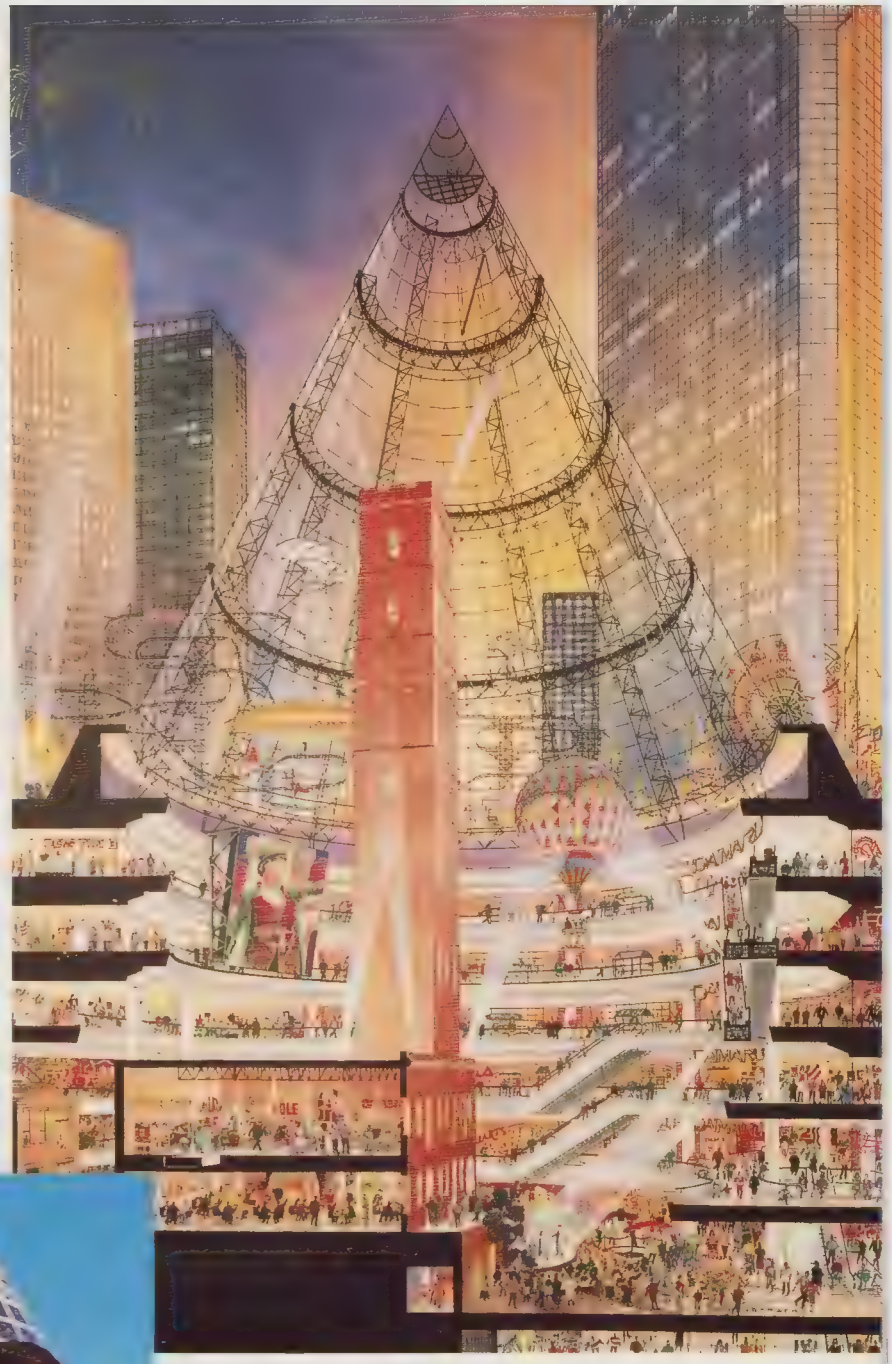
But Phil Naylor, acting national director of the Retail Traders Associations of Australia, says it has more to do with simple demographics – the baby boomers have reached middle age. More affluent than their parents, they are not so interested in discount, one-stop shopping as in quality, service and knowledge about products.

Quality, service and knowledge cannot be provided by stores aiming to capture the mass market. They need to specialise. Specialisation, Mr Naylor says, is the way of the future – at least until this generation of ageing baby boomers passes on.

In Australia, specialisation can be seen in chains such as The Body Shop. But in the US, an organisation called The Limited Inc. is taking specialisation to its logical conclusion. Now with a $5 billion annual turnover, it began as a chain of fashion stores catering for women aged between 15 and 25. As customers aged, so did the stores. Merchandise in The Limited stores was changed to suit women aged from 25 to 45, and a new chain called Express was established to cater for the younger women. Later, Limited 2 was introduced to cater for 5 to 15 year olds; Victoria's Secret sold lingerie; Lerner New York sold moderately priced high fashion; Lane Bryant catered for larger sizes; Portfolio sold men's clothing; and Henry Bendel and Abercrombie and Fitch were bought to cater for upmarket career women and the wealthy aged respectively.

According to Tony Joyce, a director with the US-based Management Horizons research consultancy, the success of The Limited has done away with the concept of the mass market. "It is getting close to its customer," he says. Customer loyalty, he says, will become increasingly important because of changing demographics in both the US and Australia. With ageing populations and less time to waste, shopping frequency will decline. This is already showing up in statistics from the US where, during the 1980s, the average number of visits to malls fell from three per month to two and the average number of hours spent in the malls fell by two-thirds to four hours per month.

As shopping frequency declines, purchases will be more planned and less impulsive. Customers will do less comparative shopping. Discount stores will lose market share. "Relationship merchandising" or "category killer" stores – operations that concentrate on closely relat-



MELBOURNE CENTRAL

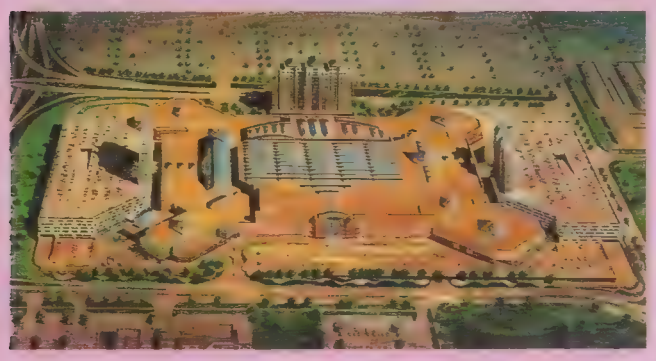
DAVID JOHNS

Above: Melbourne Central
Left: Daimaru Australia managing director Tsutomu Okuda with sales staff member Emma Callil.

Mall of Fame

The Mall of America sits in Bloomington, Minnesota. Bloomington is a satellite city of Minneapolis. The city is not large but the mall will be America's largest. Almost 80 per cent completed, both architects and developers are still fond of talking in statistics. Total mall area 380,000 square metres – four times bigger than Warringah Mall in Sydney; number of stores 800 – 500 more than in Melbourne's Chadstone; number of car parking spaces 12,800 – 7800 more than at Highpoint City in Melbourne; size of covered Snoopy Land funpark 4 hectares; number of hotel rooms 1500; number of department stores 8; total length of each floor 1000 metres; estimated total cost of all phases US$1 billion.

MALL OF AMERICA



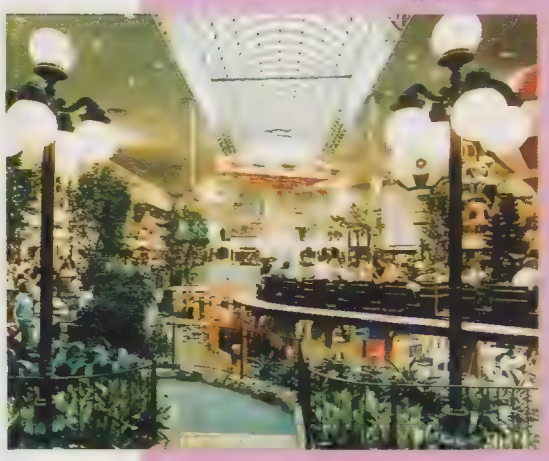
According to head architect Bob Deeiel, the mall is so large that even America could support only two or three of them. Mr Deeiel is a principle with the Californian firm The Jerde Partnership, the leading US architecture firm in shopping centre development. He describes designing the Mall of America as "a very big challenge."

"It is so big," he says. "You could walk two miles on each of the three levels. So even though you're likely to get tired, our challenge is to stop you getting bored." As in new and renovated shopping centres in Australia, the mall has been separated into various areas of "ambience" – one section has the character of New York, another that of New Orleans, a third the ambience of the Grand Canyon.

Developers hope to regularly attract people from as far as 800 kilometres away and are anticipating that their "serious trade area" stretches as far as 500 kilometres. "There will be enough in it to keep people entertained and shopping for three days," Mr Deeiel says. "And we are hoping it will become a tourist attraction."

Leon Nitsun, vice-president of developers Melvin, Simon and Associates, describes the Mall of America as an attempt to combine retailing and entertainment in "a big way." The formula was successfully applied by joint partners in this project, the Triple Five Corporation, when they built the West Edmonton Mall in Canada. The biggest of its kind in the world, it has become a major tourist attraction for the city.

AUSTRAL INTERNATIONAL



But Mr Nitsun says that it was the expressions of interest from department stores for space which sparked the Mall of America project. "Without them, you don't have regional shopping centres," he says. "They are still the main drawcard."

ed or only one merchandising category – will emerge and dominate. Many will be overseas-based, each store will be huge and their staff will be specialised, knowledgable and empowered to make decisions at point of sale.

Retailers will develop closer relationships with their suppliers and manufacturers. According to Mr Joyce, if retailers do not own their suppliers, it will appear as though they do. Britain's Marks and Spencer is the best example of this in the world, he says. They can rely on quality, quantity and speed in restocking. Bar-coding in supermarkets will be put to a similar use – details of the bought item will be automatically transferred from point of sale to supplier.

The huge investments many companies have made over the last decade in micro-marketing should begin to pay dividends. By collecting masses of information about their customers – not about the general population on the street but about people in the store – retailers say they are better prepared to target a specific market. As one retailer says: "You spend your time coming into our shop because your needs are being met. We've been identifying those needs."

Melbourne Central has spent much time identifying our needs. Letting her eyes rise towards the ceiling, marketing manager Lysette Foster speaks of hot air balloons, perpetual motion machines, butterfly enclosures, two-storey video screens, life-sized replicas of the Wright Brothers' bi-plane. All have the purpose of drawing customers' eyes upwards. This, she says, keeps people moving up and through the vast complex; as in cathedrals, they subconsciously want to rise up and up.

The religious analogies continue. In an order as complex and rigid as Dante's Hell, Purgatory and Paradise, retailers in the new centre have been allocated space on one of three levels in one of five worlds. The three levels are named Good, Better and Best, the worlds are Action, Urban, International, Historical and Crystal. Sportsgirl, for example, is found on the Better Level of Action World. The lighting and fixtures vary in each world but the changes are subtle, sending subliminal messages to customers. Subconsciously anticipating the next world, they will be drawn on and on and on.

Lysette Foster does not make it sound so, yet Melbourne Central is a huge gamble. Not only have shoppers increasingly forsaken the CBD for the suburbs over the past 30 years, but Melbourne Central wants to move the centre of Melbourne a full city block north. It also wants 24.5 million shoppers to pass through its many doors each year – half a million more than the Queen Victoria Building in Sydney and double the amount of shoppers visiting Chadstone. It plans to do this without a fun park or an eight-theatre cinema complex.

But Melbourne Central has spent many years and millions of dollars anticipating Australians' future retailing behaviour, and believes it will attract shoppers. They cite these figures: the CBD may have lost market share, but it is still by far the largest single retailing centre in Victoria; 14 million people a year use Museum Station over which Melbourne Central is located; and 80 per cent of people who shop in the CBD have made a special trip to do so.

Following Daimaru's example, young, energetic people will act as a "courtesy crew", greeting customers as they arrive, cleaning the windscreens of cars left in the 1600-space car park, carrying packages. The frail, elderly and disabled will be provided with small battery-operated vehicles in which to move around the complex; a team of guards and electronic devices will maintain security; and a child minding centre and father/mother changing rooms will be available.

Ballets will be previewed, art exhibited. In-house video programming and advertising will be projected continuously on the giant screen. And every hour, on the hour, puppets will emerge from the huge "historic" clock, manufactured by Seiko, and dance. By simply responding to what people do and want to do, marketers say that Melbourne Central is leading retailing into the future. Customers, they say, want to be entertained, indulged, educated. They want to be allowed to escape, if only briefly, from their "boring daily lives."

Libby Lester is a freelance journalist based in Melbourne.

Triple-R 102.FM is Melbourne's premier Public Radio broadcaster

Each week Triple-R broadcasts to 100's of thousands of Melbourne listeners in it's multifunction role of entertaining, educating and informing – breaking down barriers and creating award winning standards.

In the late seventies, in the early days of Melbourne's public broadcasting, Triple-R began its fledgling efforts from a cramped terrace house in the inner suburbs. Soon it was to prove itself a vital force on the air-waves with its unique blend of education and alternative music – education in the broadest cultural sense, music that set trends.

Those early years have become legend with their heady blend of adventurous programming, live-to-airs, concerts and crucial involvement in the local cultural scene. The good news for the next decade is that the popularity and influence of Triple-R continues unabated. Programming is as varied and adventurous as ever and the audience continues to expand into the 100's of thousands.

Triple-R is the most listened to public radio station in Australia with an audience of 323,000.

Roy Morgan Research – 1987

Best radio station in Melbourne.

Rolling Stone Magazine
Readers Poll 1990

Public Radio enjoys a special relationship with its audience because it receives their direct financial support. Each year Triple-R draws on its 300,000 plus audience to expand its subscriber base with a radiothon sdding new support to its innovative and exciting program lineup. In 1991 this means a 24 hour a day 10 day subscription drive from August 16 to August 25. Listener subscriptions and sponsorship from the entertainment industry are now a major part of the Triple–R budget. Great prizes from sponsors offer additional incentive for subscriber support.

With an annual budget of only $600,000 – Triple-R is truly the 'low cost, high interest' radio station.

To meet the technology challenges of the next decade, 1991 will see new standards of transmission equipment at the Mt Dandenong transmitter site.

This development project for the 1990's will require a significant injection of additional funds, and Triple-R will look beyond its traditional support base. The corporate community will be invited to assist in this project with the very real benefit of being able to reach the unique audience of public radio, a very large audience seldom reached by the commercial media.

A Transmitter Appeal has already been launched and will ask the corporate community to see themselves as corporate citizens in the 1990's and go beyond the bottom line with acknowledgement and financial support for the important role played by Public Radio in the wider community. $170.000 is needed for new transmission equipment and already suppliers and the entertainment industry have given their support. Broad support from the corporate sector will be strongly identified by the Triple-R audience.

The Triple-R audience is seen as one of peer group leaders, educated and discerning.

In January – June 1990 a Roy Morgan Consumer Research Survey found that over 80% of Triple-R listeners are under the age of 35, that 54% have been or are now engaged in some form of tertiary education, and that they are culturally active and 'socially aware'.

"...the coolest of the youth stations"
The Age 1990

The Triple-R audience is characterised as 'young optimists' seeking to improve their prospects in life and the 'look at me' group seeking an exciting life, an eye to fashion and trends.

The lifeline to the Triple-R audience is kept flowing by the combined talents of 10 full-time staff and over 90 volunteer announcers creating more than 70 different radio programs to cater for a diversity of tastes. The volunteers may be teachers, stockbrokers, lawyers, students and musicians who all share an abiding passion for radio – whether it be working on talks programs or presenting music shows.

Current affairs, environment and specialist music programs emanating from Triple-R are networked weekly across more than 20 other public radio stations throughout Australia.

Triple-R is educational, informative, provocative, challenging. Most of all, our listeners tell us that Triple-R is entertaining. Triple-R has never been radio for the background, it is more likely to leap into the foreground and demand attention. Triple-R programs are continually attracting awards from around the world.

The next decade presents new challenges – the changing inner urban and suburban communities, multiculturalism, the altering nature of the workplace, increased leisure time, the 'techno' society, the aging population, the 'clever' country. All these factors facing Triple-R in this next decade ensure that the station will never become a stagnant repository of stale programming ideas. As a vision driven organisation, Triple-R will continue to reach out into its community, to enhance its facilities with new technology and to play an increasingly important role in the developing culture of Australia as we move into the 21st Century.

CORPORATE VISION

TRIPLE-R FM MISSION STATEMENT – laid down in 1990

To educate, inform and entertain by drawing upon appropriate community resources to develop a critical approach to contemporary culture.

Black Australia's best hope

Australia's enduring racism must be addressed for the sake of future generations, both white and black.

One of the most enduring myths about modern Australian society (that is, Australia since 1788) is the myth of egalitarianism. It arose even though this country's origins were clearly based on unequal divisions of class, sex and race.

By January 1788, notions of racial superiority were already deeply ingrained in the British who were transported to Australia, either as convicts or their keepers, and strongly reinforced by the moral force of the Christianism they brought. Although it was almost a century in the future, the seeds of social Darwinism were already swelling in the consciousness of the Western (European) industrialised man. Against that background it is no surprise that since the advent of modern Australian society, the Aborigines, the indigenous peoples, have been characterised as less than human.

PAT O'SHANE

All of the ideological baggage bought by the British invaders was used to justify treating Aborigines in ways consistent with such a characterisation. As a consequence they were murdered and dispersed, dispossessed, impounded on reserves and in every other way denied all basic rights as human beings. Every institution of the new society gave legal and moral sanction to these practices.

The legacy for Aboriginal Australians is that they suffer health profiles found only in Third World countries, that life expectancy rates are 20 years less than that of non-Aborigines, that Aborigines continue to be the least housed, least educated and least employed in the entire Australian community. Aborigines are the most frequent victims of racist abuse and, most damning of all, Australian Aborigines are the most incarcerated indigenous people in the world.

Aborigines have been rendered utterly dependent people. The legacy for non-Aboriginal Australians can be counted in massive dollar terms: Aboriginal Affairs budgets amounting to hundreds of millions of dollars still fail to overcome problems of housing, ill-health, unemployment, lack of education etc. It can also be counted in the millions spent on inquiries into Aboriginal housing, Aboriginal health and most recently the costly and long Royal Commission into Black Deaths in Custody. Non-Aboriginal Australians cannot be shielded from the social costs of the excessive rates of violence, illness, unemployment and imprisonment suffered by Aboriginal Australians. An enduring legacy is international approbation, as well as social disharmony and discord.

It is worth remembering that these conditions continue after more than 200 years. True, Aborigines in 1991 are better off than in 1941, however the yardstick is the position of Aborigines compared with other Australians. When that comparison is made it is clear that the position of Aborigines has not significantly improved.

My vision for a preferred future for Aboriginal Australians then is a long-term one. Under it, Aborigines would enjoy the same standards of living, the same quality of life, the same employment rates, the same educational participation and levels of attainment enjoyed by all other Australians.

However, it is not to say that Aborigines would live the same lifestyle as all other Australians. There are some significant factors which distinguish Aboriginal lifestyle, among them a unique identity and cultural heritage. That has to be not only recognised but also respected and assured by Australian governments. That identity relates very closely to the land, so one of the first issues to be addressed is Aboriginal land rights.

Australian governments should cease moving Aboriginal people into towns and cities under resettlement programs and ensure Aboriginal title to areas of land which the people themselves identify as being meaningful to them. This is not a process of apartheid, which is forced separation, rather land rights would be meeting the articulated needs of the people themselves. Governments should provide sufficient monetary and other resources to enable these Aboriginal communities to become fully functioning independent communities. The process is a simple one, and there has been a precedent for what I have in mind. In NSW in the early '80s, representatives of communities throughout the State were brought together to discuss housing needs.

The people identified where the needs were and drew up housing programs to meet the areas of greatest need. The consultation process was very lengthy but the significant aspect of the consultation process was that it was the people who owned it: they controlled it, they took responsibility for it. They had very lengthy consultations back and forth with their own communities and with government. They then became responsible for allocating funds to training programs, employment programs, construction programs.

Nowhere in Australia are there Aboriginal communities so large in numbers that similar processes could not be implemented, right through each of the states, and for that matter on a regional basis. In that process there is simply no need for Anglo Australians to be involved. Already, the Commonwealth Government has established the Aboriginal and Torres Strait Islanders Commission, which is ostensibly responsible for the control and management of government funds. The process I outline would simply be an extension of that, but the people would be responsible to each other, not to government.

The benefit for Anglo Australians is that Aborigines would become independent, they would be employed in programs which they have devised, they would be educated according to programs which they have designed to meet their needs. Hopefully there would be significant reduction in alcohol abuse, violence and therefore in the imprisonment rates. Non-Aboriginal Australians may choose to share Aboriginal lifestyles and culture, and vice versa.

Altogether then, my vision of the preferred future for Aborigines in Australia is a vision for all Australians based on mutual respect and understanding, independence and interdependence. It is a future which the people themselves will own.

Pat O'Shane is a Sydney magistrate with a continuing interest in social issues, women's issues and Aboriginal affairs.

The Thinking Machine

Imagine a human being working a machine. Imagine, with the passage of time, that machine growing more efficient. Imagine that machine working on its own, thinking. Imagine what happens next...

BY IAN ALLEN

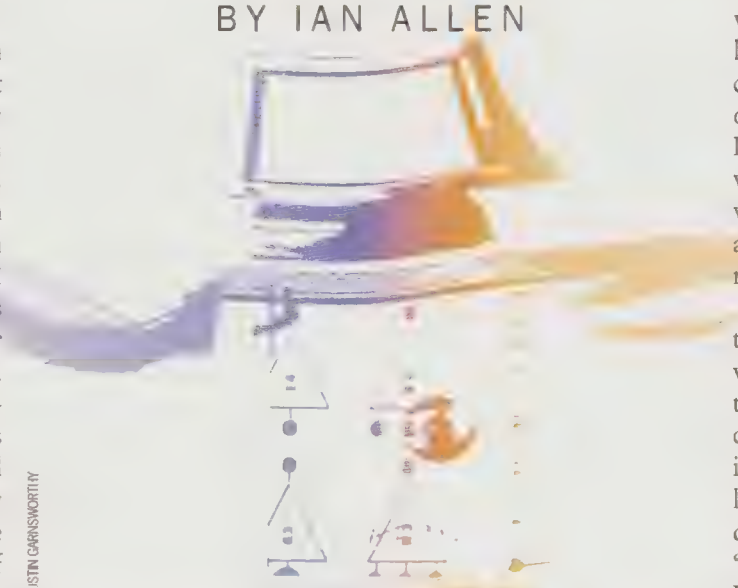


ILLUSTRATION BY JUSTIN GARNSWORTHY

In terms of human achievement, the invention of computers must rank in importance alongside the development of language, of writing and of mathematics. All are symbol-making tools, and as such they extend the power of our brain, enabling us to think and conceptualise in ways that were previously unimaginable.

Electronic computers have been with us for less than 50 years, but already it is difficult to think of any aspect or branch of science in which they have not had a profound effect. The machines are much more than mere productivity enhancers. In many cases they are the central tool that makes the research viable, as essential to a modern astronomer or genetic engineer as a hammer is to a carpenter. And computer technology feeds on itself. The computer's ability to simulate new models and test new concepts is extraordinarily useful everywhere, but nowhere more so than in the development of even newer computer technology. How else could we have designed and tested the current generation of processing chips, which have over one million switching elements in a space a third the size of a one cent piece?

It's impossible to predict where this technology or the tools we create with it will ultimately take us, but one of the most challenging possibilities is the prospect of computer-based or artificial intelligence. It's a confronting subject. We humans have always cited our intelligence as possibly the most important thing which sets us apart from other creatures. Intelligence is widely believed to be the reason we're at the top of the evolutionary heap, so what would it mean if we made a machine that was more intelligent than ourselves? Intelligence implies consciousness, consciousness implies life, but how can a machine be "alive". The concept is outside our existing definitions, all of which were developed to describe biological life as we found it on Earth. The standard characteristics of living things are growth through metabolic processes, the ability to respond to environmental stimuli and the ability to reproduce, but is this accurate? One biological form of existence which doesn't fit the description is the virus.

A virus is a piece of dna wrapped up in a protein coat. It does not have the machinery to reproduce itself, so it doesn't fit our existing definition of life. But the virus does reproduce. It invades a living cell and steals control of the cell's reproductive machinery, often killing the cell in the process. Is it alive? We talk about it as if it were. The medical literature on any viral infection is full of discussions about how best to kill the virus responsible.

The point is that it's possible there may be other forms of existence which do not fit our present definitions of life. In time, we may need to change those definitions. That means it is conceivable that one day an intelligent machine might match a revised definition of life and be recognised as 'living'. But what would it think? Would such a machine see its human creators as God, or would it see us as we see dinosaurs, as evolutionary once-weres? Is it quite possible that in creating such entities, we may sow the seeds of our own destruction?

This last question is really as ancient as the story of the Garden of Eden or Pandora's box. It's the question of forbidden knowledge. Dr Frankenstein's monster destroyed him, and the moral of Mary Shelley's story was clear. Humanity's advancing science might be able to imbue dead matter with life, but it could not create a soul; that was God's domain. *Frankenstein* was first published in 1818, at a time when the experiments of Galvani, Volta and Davy had begun to reveal some of the secrets of a completely new and unknown force with almost magical properties: electricity.

Today we're nudging at the edges of a new suite of revolutionary powers; genetic engineering, nanotechnology and artificial intelligence. As in Mary Shelley's day it's not surprising that the theological "thou shalt not" theme still echoes. Popular films such as *Westworld*

and *The Terminator* restate the moral of destrpuction. But among the science fiction community there exists an opposing view; that if intelligent machines are to built, they will be built with safeguards, in the same way that electricity systems have safeguards. Electricity may be extremely dangerous, but with the proper safeguards it's proven to be incalculably beneficial.

Isaac Asimov is one of the greatest proponents of the benefits of machine intelligence. He has even gone so far as to develop what he calls the Laws of Robotics. (see page 78).

Asimov's laws look fine on paper, a combination of safety, service and prudence. The laws were originally proposed as a way of breaking the machine-monster syndrome. *I, Robot* and *The Rest of the Robots* are collections of short stories exploring how these laws might work in practice and in a future where the machines are indeed intelligent. His laws could well work, but nowhere in his writings does he address the problem of how or where we cross the dividing line which separates dumb machines from intelligent ones.

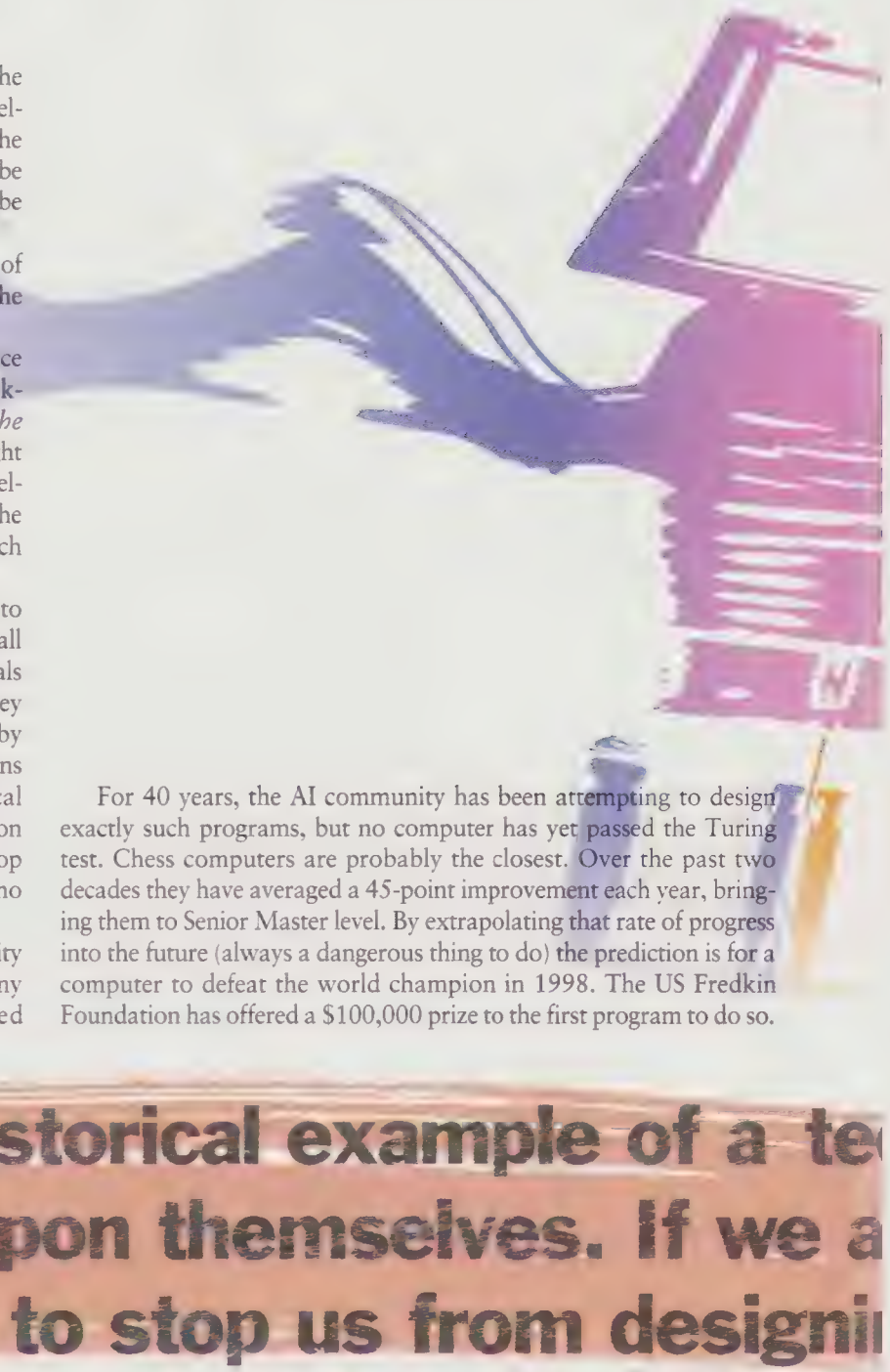
At the moment, many of our machines are expressly designed to kill people. The "smart" bombs of the Gulf war are actually not at all intelligent. They are homing weapons which rely on physical signals to guide them. They may be using a laser reflection, but in essence they are no more intelligent than the magnetic homing torpedoes used by the Germans in World War II. They are, however, ingenious weapons of destruction, purposely built by humans. There is no historical example of a technology which humans have not chosen to turn upon themselves. If we are to develop intelligent machines, what is to stop us from designing them to destroy our enemies? In other words, who or what is going to enforce these laws of Asimov's?

A second problem that Asimov does not address is how humanity will overcome the inevitable social disruption which will accompany the introduction of intelligent machines. What will we need people for? To fix the machines? Why shouldn't they be able to fix themselves?

But how much of this is hypothetical? How realistic is the notion that a machine could think, and can a machine have conscious thoughts in the same way that human beings do?

Proponents have argued that the human mind is itself a machine. It may be electro-chemical, and we may not yet understand how it functions, but essentially it must be subject to the same laws of physics as any other machine. As soon as we understand those laws more fully and have a better idea of the micro-functional structure of the brain, we should be able to build machines which can equal or even exceed the human capacity for thinking.

The theoretical basis of artificial intelligence goes back to the British mathematician, Alan Turing. In 1950, he proposed a test by which we could determine whether or not a machine could think. The Turing test, as it has become known, is quite simple. If a computer can perform in such a way that an expert cannot distinguish its performance from that of a human who has a certain cognitive ability – say the ability to do subtraction – then the computer must have that ability. So if we could design programs which simulate human cognition in such a way as to pass the Turing test, then those programs would no longer be models of the mind, they would literally be minds, in the same sense that the human mind is a mind.



For 40 years, the AI community has been attempting to design exactly such programs, but no computer has yet passed the Turing test. Chess computers are probably the closest. Over the past two decades they have averaged a 45-point improvement each year, bringing them to Senior Master level. By extrapolating that rate of progress into the future (always a dangerous thing to do) the prediction is for a computer to defeat the world champion in 1998. The US Fredkin Foundation has offered a $100,000 prize to the first program to do so.

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But would we accept such a program as a "mind"?

John Searle thinks not. A professor of philosophy at the University of California, Berkeley, he is an outspoken critic of the claims of what he terms Strong AI – the approach that believes thinking is merely the manipulation of formal symbols – exactly what the computer does, and that the mind is to the brain what the program is to the computer.

Searle dismisses the Turing test as meaningless. One of his arguments is a thought experiment, The Chinese Room, in which a man who understands no Chinese translates between incoming and outgoing messages in Chinese. He does this by performing pattern replacements, according to the rules in a book. To the people outside, the room passes the Turing test by conversing in Chinese, but the man in the room has absolutely no idea what is going on. He is simply following the instructions in the book. The analogy is that the man in the room is the computer and the book is its program. Searle argues that neither the computer, nor its program have the human ability to attach meaning to the symbols they manipulate, and because they can't attach any meaning to their "thoughts", the process can't really be described as cognitive.

Instead, Searle prefers the claims of what he calls "weak AI". This is a more cautious approach which views computer models as being useful in studying the mind, but only in the same way as they are use-

ful in studying weather systems, or economics, or molecular biology. A computer model might be able to simulate something, and from that simulation we might gain useful knowledge, but simulation is not and will never be the same as the real thing.

Many people within the AI community disagree with Searle. In January 1990, *Scientific American* published an extended debate between Searle and Paul and Patricia Churchland, both professors of philosophy at the University of California at San Diego. They agreed

nology which humans have not chosen to develop intelligent machines, them to destroy our enemies?

with Searle that the Turing test is not a true test of machine intelligence, but they still argued that there is a case for strong AI. In particular, they argued that while conventional serial computers are incapable of emulating the human brain, the jury is still out on neural network computers.

Neural network computers are an attempt to emulate some of the architecture of the human brain. Although the speed at which our neurones 'switch' is thousands of times slower than a computer circuit, our mind seems to be able to outperform the fastest computers because it has an enormous amount of interconnectedness. There are roughly 10 billion neurones in a typical brain, and each neurone is, on average, connected to 1000 others. We still have very little idea of how this network forms a cognitive mind, so the task of emulating it is not going to be easy. It will require a great deal of effort and research, and time, but the Churchlands argue that there is no compelling reason why the task should not be possible.

Whatever the merits of the two arguments, one thing is very clear: the day where a machine can match a human being in intelligence is still a very long way away. If we are to ever see a computer as clever as the HAL 9000 portrayed in *2001, A Space Odyssey* it won't be until much, much later than that title suggests. We are not yet even remotely near having the technology to build something as massively parallel as the brain, and we still have frustratingly little understanding of how that complicated few kilograms of matter physically works.

But that's not to say that there isn't a lot of practical work happening in AI research – there is. Especially if we stop using human intelligence as the yardstick for comparison.

In broad terms, the centre of the action is around what are called "knowledge-based expert systems". These are software packages which are intended as "intelligent assistants" to advise a human in problem solving tasks. They work on the principle that most human experts become expert by developing a series of rules of thumb. When approaching a new problem, a human consciously or unconsciously uses these rules of thumb to make choices about the best approach to the problem. If the first choice is unsuccessful, a human uses another rule of thumb for the next attempt. If your key doesn't fit in the door, what do you do? Check that it's in the right way. If that doesn't work, is it the right key? Is it the right door? Is the rent overdue? And so on.

In theory, to get a computer to behave like an expert, all you need do is ask a lot of experts which rules of thumb they use, and then code them into a computer program as a series of if/then rules. This approach is known as heuristics, and the rules derived form the knowledge base of the system. To the knowledge base is added what is termed an "inference" engine. It's not an engine at all, but software designed to answer a given question by evaluating the known facts and searching the knowledge base for rules to which the facts might apply.

As well as heuristics, some expert systems still make use of the computer's brute processing power. Chess computers are one example of this, but instead of attempting to calculate every possible move, they will abort a line of search if the heuristic rules say it is not a good idea. For example, it is not a good idea to exchange a queen for a pawn, so the computer would not waste time evaluating the position further. Actually there are cases where such a move might prove devastatingly successful, but the more advanced chess computers are sophisticated enough to deal with those.

In general, the brute processing approach relies on mathematical formulae or algorithms to search for answers, and the heuristic approach relies on knowledge. The two approaches work well in combination, because a little knowledge can drastically reduce the time spent in searching, but a lot of searching can partially compensate for inadequate knowledge. Heuristics and algorithms are effectively the foundation of expert system technology. They are also why the 2001 computer was called HAL, an acronym of Heuristic/ALgorithmic. The coincidence that the letters HAL each come one place in the alphabet before the letters IBM had nothing to do with it.

Mycin, the first expert system, was developed in 1976 at Stanford University. It was used in a relatively narrow field, specifically to help physicians determine whether a patient had bacteremia or meningitis. Outside of that task it had no knowledge at all, but in what it was designed to do it proved more consistent in diagnosis than the medical specialists themselves. More importantly, it was a spectacular demonstration of the potential benefits of the expert system approach. In any organisation, the resident experts are estimated to spend 80 per cent of their time sharing their knowledge and only 20 per cent actually

applying it. Any technology which improves this ratio has obvious economic benefits.

The impact of Mycin was felt throughout the developed world. In Australia, it prompted BHP to start its own R&D into knowledge engineering. The work is based in Newcastle at BHP's Central Research Laboratories. So far, two expert systems have been put into practice, both in the steel division. The first of these, Sinter, is designed to give real time advice to the operators of the slab and plate division's sintering plant.

Sintering is a metallurgical process where metal powder is heated and compressed to form a solid casting. There are a large number of variables to be controlled, and the operators have to be able to recognise and correct conditions which can dramatically reduce production quality and efficiency. The Sinter expert system is connected to the plant's sensors, so it has real time access to the condition of the line. Most of the time its displays simply monitor what is happening, but when imbalances occur it provides the operator with a recommended corrective course of action. It is still up to the operator to accept or reject Sinter's advice.

The second BHP application is designed to address a problem that AI technologies are particularly well suited to – the problem of complex planning and scheduling. Typically these applications are characterised by an almost infinite combination of possible solutions and cannot be mathematically optimised. BHP's Port Kembla Caster/Hot Mill complex is using the "Intelligent Planning Assistant" expert system to assist in drawing up the weekly production schedule. Initially the system was used to check manually-drawn schedules against a knowledge base of "plant rules" – rules within which the plan must operate. At present it is being used in an interactive way with the human managers, allowing them to electronically manipulate new plans as they design them. Ultimately, it will automatically generate the plans itself, finding optimum ways of meeting specified weekly objectives.

A similar scheduling problem exists at airports, where a finite amount of airspace has to carry an ever-increasing load of traffic. The problem is not of air safety, but rather that the air safety rules demanding minimum airspace between aircraft mean that there is a limited rate at which planes can be landed. If aircraft arrive at the airport faster than they can be landed, they have to circle in a holding pattern – effectively an aerial queue.

It's much more than an inconvenient delay for the passengers, it's a massive cost to the aviation industry. As well as the fuel needlessly burnt, airframe life and maintenance rates are determined by time spent in the air. In 1990, Stanford Research International estimated that by the end of the decade, airport congestion in Europe alone will cost $US10 billion.

In November and December, Sydney airport will test a locally-developed expert scheduling system called OASIS. Developed by the Australian Artificial Intelligence Institute, it's been designed as an intelligent assistant to the flow control manager. It's fast, taking about 30 seconds between updates, and clever enough to infer wind speeds and directions by observing variations in an aircraft's approach rate. It takes much of the calculation out of the flow control manager's job, and offers suggested sequences for human evaluation. If the trials prove successful, OASIS could make a very real difference to congestion in Australian airports, and could well find an international market.

One problem with expert systems is the time-consuming process of building the knowledge base. It ties up both the AI programmer and the human expert being consulted. On large projects, this phase can take months, even years, and it's become a serious bottleneck in the developing technology. One answer has been to try to find ways where an expert system can actually teach itself the rules it needs to know.

This approach means adding an element to the expert system, a machine learning system. Essentially these work by studying a large number of example cases and inferring rules from them. One such system is called EINSTEIN and was developed at Deakin University by Dr Geoffrey Webb. Machine learning systems do have a limitation in that the data set of example cases is almost never complete. There are too many combinations of real possibilities to ever cover every situation. EINSTEIN is used to create the equivalent of a "first draft" knowledge base, which is then further refined by human input. It is a tool to reduce the knowledge acquisition bottleneck, but not eliminate it entirely.

The notion that a computer may be able to infer rules from a set of sample cases raises an interesting question. Could such a computer discern rules or patterns that have so far eluded human experts in a field? In a novel experiment, Geelong hospital's Dr John Agar is using EINSTEIN to evaluate a database of kidney disease cases. The hospital has some 270 case records containing symptoms and diagnosis. EINSTEIN was presented with half the cases, and after inferring a rule system, was asked to diagnose the other half. The system achieved a 50 per cent accuracy, which, while certainly not good enough for medical practice, did hypothesise some novel rules for the doctors to consider. The results are not yet in, but the possibilities inherent in the idea are tantalising. For example, Sydney's Taronga Park zoo is compiling a database on shark attacks. Each record deals with more than 100 different factors relating to the attack. Could a machine learning system examine such a database and find a common pattern which determines shark attacks?

Most of the expert systems described in this article require a minicomputer or mainframe, but you can purchase expert system shells which will run on a PC. These shells contain the inference engine and user interface, but it is up to you to build the knowledge base.

Even at the present state of the art, there seems an endless range of possible applications for AI technology. It seems a very logical tool to apply to situations where human operators are required to control complex situations. Would we have had a Three Mile Island or Chernobyl if expert systems had guided the operators? Would the Lauda 767 have crashed in Thailand if the pilots had a computer to help diagnose the fault instead of having to manually refer to a flight procedures manual? Until the cost and power of personal computers drops another order of magnitude, it's unlikely that we'll see everyday consumer products employing the technology. At the present rate of progress, that day can not be very far away.

Ian Allen is producer of the ABC television show, Quantum.

ASIMOV'S LAWS OF ROBOTICS (1940)

1. A robot may not injure a human being, or, through inaction, allow a human being to come to harm.

2. A robot must obey orders given to it by human beings except where such orders would conflict with the First Law.

3. A robot must protect its own existence, as long as such protection does not conflict with the First or Second Laws.

In his 1985 novel, Robots and Empire, Asimov invented an additional law which came before all of the others. He called it the Zeroth Law.

•A robot may not injure humanity or through inaction, allow humanity to come to harm.

"Some people have regarded the original laws as 'slave laws'. After all, a slave is not allowed to harm a master, must obey orders, and may even have to sacrifice his life to follow those orders. But I view the three laws as examples of the rules that have governed the use of tools since the Stone Age.

Isaac Asimov

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WONDERLAND

As national problems go, the paucity of water probably outranks even the tyranny of distance. One river system, the Murray, has all the characteristics of a very large, flat bath which the designer failed to provide with a plug.

BY GIB WETTENHALL

Water has a nasty habit of slipping away and until recently, the authorities adopted a bricks and mortar approach. Dominated by the engineering profession with its distinctly technological bias, they saw their task as one of building bigger and better dams to meet an ever-increasing demand for water in cities and in the countryside. Only in the '80s has the focus changed from one of uninhibited development to one of how best to manage increasingly stressed resources more effectively.

Australia's politicians and planners have been steeped in the tradition of the nation's Anglo-European explorers who went out with boats on their backs in search of an inland sea fringed by a pastoral paradise. Instead, they found only endless dry landscapes, leaving behind a trail of Mts. Disappointment, Hopeless and Despair for the pioneer settlers to follow. It became an article of faith, however, to turn the myth into reality. The new Australians set out to transform the landscape: to make the desert bloom through irrigation and to populate the "dead heart" through the policy of closer settlement.

Australia is the driest place on Earth. That's a fact we all learn in primary school – alongside the tragic, heroic tales of explorers dying of thirst in the deserts which cover two-thirds of the continent. With our low average rainfall of 465 millimetres per year, Australia's average annual run-off into stream and river systems is only one fifth that of Europe. Our total flow is no more than that of small countries like New Zealand or Japan.

What few realise, however, is that water consumption per head of population in Australia is higher than in most other developed countries. And it's not city folk watering their gardens who are the main culprits. It's the profligate flooding of Australian paddocks to make the pastures greener. According to the Commonwealth's review of the *State of the Environment in Australia, 1985*, urban uses account for only 18 per cent of the nation's total water consumption, compared with a staggering 74 per cent used for irrigation purposes.

The fantasies of politicians and the water planners are primarily to blame for this state of imbalance.

"They encouraged a very prodigal use of water," argues Professor Warren Musgrave, the director of the Centre for Water Policy Research, and dean of the Faculty of Economics at New England University. "Once a water storage was built, it was just chucked around without a thought to covering costs or the long term environmental consequences."

This is not a controversial view. It is a view shared by water planners and scientists, policy-makers and politicians right around Australia. While gaining prominence in the media, environmental problems associated with Sydney's ocean outfall sewage disposal or heavy metal waste production by industry pale compared to the devastation occurring beyond the veneer of Australia's urban seaboard.

Land degradation is often regarded as Australia's most serious environmental problem. Nearly two thirds of Australian land suffers from moderate or severe degradation, a proportion much higher than in any other region in the world. The most pressing problems resulting from the misuse of water are the sterilisation of whole regions through salinisation, and the fouling of water systems through nutrient run-offs.

What's at stake is most dramatically illustrated by the future facing Australia's biggest river and its surrounding ecosytem. The Murray and its tributaries drain an area of more than one million square kilometres – one seventh of the continent. Australia's agricultural powerhouse, the Murray-Darling Basin contains 75 per cent of the nation's irrigated land, producing one third of Australia's rural output. Big statistics – as, unfortunately, are those associated with the dark side of current water and farm management practices.

Recent estimates by the Murray-Darling Basin Council place losses due to land degradation in cropping and irrigation areas in excess of $220 million per year. The Victorian Government believes that without corrective action, the costs associated with managing salinisation alone will treble within 30 years. Hydro-geological studies indicate that up to 500,000 hectares of the Basin are at risk over the next 50 years.

Natural processes of wind, water and animal movement have always led to the redistribution of the salt from the groundwater and ancient rocks of the prehistoric seabed underlying much of Australia. Water management and farming practices have simply sped up the process. Clearing of trees and their replacement with shallow-rooted grasses and crops has led to a rise in watertables and an increase in the rate of salt leaching from the soil. Once a watertable is less than two metres from the surface, the accession of salt to the surface is mobilised through capillary action, killing off any remaining plant life and leaving a sterile salt pan.

Dr Joe Landsberg, director for natural resource management with the Murray-Darling Basin Commission, said that dry land salinity caused by tree clearing affects the whole triangle of land from Dubbo-Orange-Wagga, with its apex at Mildura. In some low-lying

Land gone bad: The most pressing problems are sterilisation of whole regions through salination, and the fouling of water systems through nutrient run off.

TO WASTELAND

areas, the groundwater is so high that it has bubbled to the surface creating brand new saline streams. "I've seen some scary estimates on dry land salinity," said Dr Landsberg. "If the worst prognoses come true, then we're in awful, awful trouble." Reafforestation combined with legislation to prevent any further clearing would seem to provide some hope.

In the south-west of Western Australia, half of the available water resources were judged as too saline in the mid-70s by the Water Authority of Western Australia. More than a dozen town water supplies were under threat because of increasing salinity. The blame was sheeted home to large-scale tree clearing for agricultural production, and in 1976, WA became the first state to introduce clearing controls on private land.

Five catchments were identified as in critical need. Through a mixture of controls, and $40 million spent on compensation and straight-out buybacks, "tens of thousands of hectares of forest have been saved from clearing," according to Ian Loh, the principal officer, policy and planning in the water authority.

At the worst-affected catchment surrounding the Wellington Reservoir, $4.4 million has been put towards reafforesting 6200 hectares with over four million trees over the last 15 years. The water at Wellington Reservoir is still not drinkable. "We hope to restore it to drinkable levels somewhere between 2020 and 2025," Ian Loh commented.

Irrigation exacerbates salinity problems. Where there is any run-off, it adds to the rising water-table. Excess irrigation leaches salt from the soil, increasing the salinity of water entering the groundwater and stream systems. Water applications in Australia have been generally based on a crude rule of thumb rather than any scientific investigation of just how much water a particular crop or pasture might actually need. Irrigation is carried out by flooding from gravity-fed channels to a given depth.

"A lot of basic rules were totally ignored in the construction of Australia's irrigation systems," commented Dr Landsberg. "Farmers have grown up with the idea that the more water they use, the better the crop growth. That's just nonsense. The extra water only adds to the steadily rising groundwater and the increasing salinity of the Murray River system."

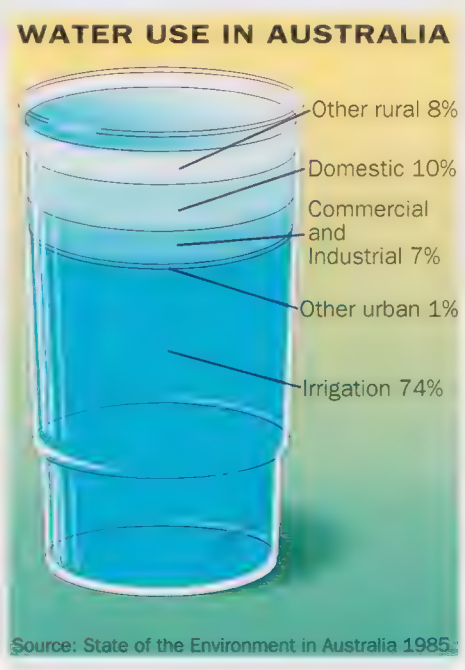
Salinity is particularly serious in the lower levels of the Murray, affecting the water supplies of Adelaide and a number of South Australian cities who are largely dependent on water piped from the Murray. Not only is it impossible to work up a lather in Adelaide, but it has become increasingly difficult to maintain the water transport systems as they clog up with salt. As a solution, the Murray-Darling Basin Commission is developing three "sacrifice areas" as evaporation basins in South Australia. Established at a cost of $40 million, the major salt interception scheme of Willpunda consists of 20 to 30 kilometres of bores on both sides of the Murray pumping highly saline groundwater into an evaporation basin.

Unlike Victoria's Rural Water Commission, neither the Murray-Darling Basin Commission nor the New South Wales Government has plans to tackle one of the root causes of the irrigators' profligacy with water – its incredibly low cost. In 1988/89, Victorian irrigators were paying a mere $30 for every one million litres of water they used. Compare this to the $400 for every million litres paid by a city dweller in Melbourne. Not surprisingly, the Rural Water Commision was operating at a significant loss of $40 million a year as gauged against a zero rate of return. Starting last year, the Commission moved towards the "key objective of financial self-sufficiency within the next 15 years" in the words of David Watson, manager of the commission's corporate planning.

The first, four per cent real increase in the price of irrigation water in July 1990 led to a rate strike by some 8000 farmers in the Wimmera/Mallee region. They are among those hardest hit by the rural recession, and form a good portion of the 82 per cent of Victorian farms where irrigation is used for the low value-added purposes of stock and pasture watering. Over the border in NSW, irrigation water costs are a third less than those in Victoria: an obvious irritant behind the rate strike and a perfect example of the uncoordinated approach which bedevils water resource management throughout Australia.

One of the aims of putting up the price of water is "to improve value-added returns in water usage," explained David Watson. That is, the commission hopes the new pricing policy will force farmers to either abandon pasture irrigation or seek higher returns by turning to horticulture or more intensive farming uses.

The only regular feature about Australian stream and river flows is their variability. Just have a look at how many of Australia's streams are marked by mapmakers as "ephemeral." As a number of explorers found to their cost, a fully flowing stream can be there one season and gone the next. The Murray is no exception. With the distinction of being the slowest flowing major water system in the world, it used to become in summer in its lower reaches, a series of billabongs. Despite the construction of the Murray's 95 locks, weirs, dams and barrages, in dry years it still fails to reach the sea. It is a river system with all the characteristics of a very large, flat bath which the designer failed to provide with a plug.



NORMAN ROBINSON

What that means in terms of water management is that the Murray – similar to many of Australia's river systems – doesn't have an adequate flushing capacity. Our river systems are remarkably fragile where it comes to ridding themselves of toxins which threaten the quality of their water and the plant and animal life forms dependent on that water.

Problems associated with sewage and agricultural nutrient run-off come a close second to salinisation, although some, such as Michele Barson, the acting director of the federal Bureau of Rural Resources, would argue they pose an even greater threat. Throughout Australia, sewage from our inland towns is discharged via nineteenth century technology trickle filtering into the streams and waterways. Rightly or wrongly, the sea is generally considered big enough to cope with the cities' sewage without system breakdown. And while algal blooms on the Hawkesbury and Parramatta rivers flourish as a result of sewage discharge from Sydney's western suburbs, once again, the worst problems are to be found among the closed, variable systems of our inland waterways.

Treating effluent by nineteenth century technology does not remove nutrients which are the prime cause of such environmental nasties as toxic blue-green algae blooms. Raw sewage contains approximately 40-50 milligrams per litre of total nitrogen and 10-15 milligrams per litre of phosphorous. Without the installation of specific nutrient removal facilities "most of these nutrient loads will be discharged to the environment in the treated effluent," points out the Australian Evironment Council, Report No. 19.

Nitrogen and particularly phosphorus stimulate phytoplankton growth, which when found in high densities can lead to oxygen depletion, placing stress on fish and other aquatic organisms. Once even the lowest forms of life are affected, then the whole food chain is damaged. Foul taste and odour problems ruin country water supplies. The growth of toxic blue-green algae can kill animal stock and has, for instance, already clogged Victoria's Gippsland Lakes on a number of occasions.

DEPARTMENT OF CONSERVATION AND ENVIRONMENT VICTORIA

A waterway that looks like a fairway: Only now are oxygen depletion and toxic algae being addressed.

Eutrophication – to give the process its scientific name – is, however, primarily caused as a result of current farming practices through application of superphosphate and nitrogenous fertilisers, and as a result of the faeces from the nation's 134 million sheep and 25 million cattle washing into the nation's water courses. More than 85 per cent of all phosphorous entering Australian waters is estimated to emanate from farms.

Algal blooms have always been fairly common, but in recent years they have grown in intensity leading to the closure of some Adelaide reservoirs for short periods. Dr Landsberg points to the increasing trend towards intensive farming in the form of feedlots, piggeries and trout hatcheries. "A feedlot with 20,000 beasts produces a remarkable amount of effluent," he remarked.

Only now is eutrophication beginning to be addressed. "The problem wasn't recognised until recently," Dr Landsberg said. "We've started mapping its extent so we can pinpoint what remedial action to take."

Where the Commonwealth's '1985 Review of Australia's Water Resources and Water Use' statistically mapped the extent and use of the nation's water resources, the Water Quality Strategy takes the next step towards a more rationed and rational approach to water usage. Launched last year by the Australian Water Resources Council, the strategy aims to draw up a series of guidelines for water resource managers to discuss and consider.

The Australian Water Resources Council consists of representation from all state ministers responsible for water management. Its overarching role may provide the best shot for developing a more integrated approach on issues from reafforestation of catchments to pricing policies for end users of water.

Professor Barry Hart, director of the Water Studies Centre at Monash University, is one of those rewriting the management policies. "There's no question that water management in the future is going to be concerned with that buzzword, sustainability," he said. "We'll be looking to minimise man-made inputs and how best to protect ecosystems, rather than simply protecting water quality for drinking and for agricultural purposes."

Dr Angela Arthington, the director of the Centre for Catchment and In-Stream Research at Griffith University in Queensland, also believes that a "new dawn" is at hand. Her research has led her to the conclusion that to keep Australia's streams functionally healthy, we are going to have to learn how to mimic their highly variable water flow patterns. Dam building transforms seasonal patterns, turning them inside out, disrupting the survival and dispersal of the aquatic biota from bacteria through to fish. Every nuance of natural flow has its place in the maintenance of a habitat which favours all forms of life. "Flood flows, for example, clear out weeds and scour out sediments, while some fish migrate during floods," Dr Arthington pointed out.

A meteorologist working on the Water Quality Strategy, Dr Neil McDonald, commented that there are a number of "mindsets" which need to be changed through the adoption of what he described as "best management practices." As one example, he cited the need for the adoption of low impact farming which was not only as pesticide and chemical free as possible, but also brought in micro-jet sprays for irrigation. "Similar in principle to those do-it-yourself spray systems found in many people's backyards," he mused.

Peter Christoff, assistant to the Victorian Commissioner for the Environment, would go even further on the issue of irrigation. He is carrying out a major study and believes low value irrigation for pasture production ought to be phased out. Searching for technical solutions only delays the inevitable, he argues.

Professor Musgrave agrees that there is still a preoccupation with the technological fix, and points to the failure of the Murray-Darling Basin Commission to carry out any socio-economic research. Inevitably the need for more capital intensive forms of efficient irrigation, coupled with higher water prices, will lead to bigger farms and more intensive farming. "How are we going to shield the winds of change from these communities?" Professor Musgrave asked. "These people must not be hurt because society as a whole created the situation through the past incentives provided to over-irrigate and to clear land."While Dr Landsberg might not understand the fine detail of the massive socio-economic effects facing rural communities, he does acknowledge that billions of dollars from urban Australia will be required to repair the damage and maintain the existence of those living in the bush. "We need to face it and realise that it's an exercise as large in scale as was the construction of Canberra," he said. "And that like the building of Canberra, it could take over 30 years."

Gib Wettenhall is a freelance journalist based in Melbourne.

Magical Music

Will DATs take over from CDs? How does Natalie Cole manage to sing duets with her dead father, Nat King Cole? The answers to these and other important questions lie in the future of music

BY ANDREW MASTERSON

Technological innovations in music during the past decade have left many people, musicians and non-musicians alike, in a state of misty bewilderment. The ability to perform even a simple tune like *Three Blind Mice* seems often to depend more on an acquaintance with logarithms than traditional musical skills.

Similarly, for a growing number of music consumers, how a small reflective disc with writing all over it can possibly produce Madonna pouting her way through *Vogue* is an utterly unfathomable mystery. Wittgenstein was fond of pointing out that whereof we cannot speak, we must remain silent. It's a fine enough approach in the matter of the eternal verities, but when that whereof is the insides of your CD player, or the thing the hairy gentleman on stage is hitting, it tends to cause more problems than it solves.

Rapid change in any field is perplexing, but when that change is in a field dedicated to the creation of beauty, fun, frolic and joy it is particularly perplexing. Thus, we sit and listen to someone produce what sounds like the string section from the Berlin Philharmonic by pressing one note on a keyboard, and wonder. Then we go out and purchase a CD of the same piece of music and wonder twice as much. Like watching a magician, we are distracted from the fundamental qualities of the act by trying to figure out how it's done.

We suffer from a mild but persistent technophobia, combined with a creeping, vaguely paranoiac feeling that somehow, somewhere along the way, we've been conned. (My mother told me, when I was four, that the guitars The Beatles had on telly were fake. Real ones, she said, were much thicker. I believed that for years.) There is, however, one way of understanding all musical technologies, new or old. There is a formula, as fundamental as E=mc2, that explains every type of machine for making or reproducing music, whether it be a tuba, Hammond organ, Yamaha DX7 digital keyboard, CD player, vibraphone, or recorder, descant or DAT.

It is this: The music goes round and round, and it comes out here. If we bear this in mind at all times, everything will make sense.

The type of technoshock we experience when confronted by digital and computer technologies in music is not new. It's happened a few times before, when new machines have presented us with a quantum leap in making or hearing sounds. It is not hard, for instance, to imagine the reaction of people hearing for the first time one of Thomas Edison's tin foil cylinder recordings in 1877. It would have been even more extreme, perhaps, than the reaction of those present in 1979 at the Phillips research laboratories at Eindhoven in the Netherlands, when the first CD player was demonstrated.

There have been others, however, that have faded from memory, cases of music-making innovations that rapidly became not only the norm, but led to the creation of a musicosocial millieu so vast and diverse that it became the aural bedrock of Western society in less than two decades. These changes came about when a few chaps worked out that if you stretched some bits of wire across a plank of wood, ran an electrical current through the thing and hit it, it would go twang-biddily-biddily-doo.

The electric guitar hit the market in commercial quantities in the early '50s, the electric bass a few years later, and music has never been the same. The answer to the question of who really invented the solid-body electric guitar is the subject of much boozy debate in band-rooms. It doesn't matter, really, especially given the gulf between inventing and marketing. (Leonardo da Vinci might have invented the helicopter, but Sikorsky made the money.) The electric guitar was clearly an invention in need of inventing by the mid-'30s and Adolf Rickenbecker came up with his first one about that time. In the '40s, Paul Bigsby made one for Merle Travis. Les Paul's first prototype became known as The Log because of its solidity.

It is Leo Fender, however, who must be accorded the credit for producing the first commercially available solid-body electric guitar. He made it in Fullerton, on the outskirts of Los Angeles, in about 1948, and called it the Broadcaster. A little later he changed its name to the Telecaster, because the Gretsch company (later another maker of fine guitars) already had a drum kit out bearing the Broadcaster tag. The Telecaster bore the three essential design features of a solid-body electric. First, obviously, it was solid. Second, sound was conveyed to the amplifier through microphonic pick-ups positioned beneath the strings. Third, it had a "cut-away": an alteration to the lower curve of the body at its junction with the neck to allow the performer easier access to the lower frets.

The Fender business, owned by CBS since 1964, still make the Telecaster. Apart from minor model-to-model alterations (for instance, some models have a single pick-up, others two) it has not changed at all. The beginning of the new technology was also, simultaneously, its optimum expression.

Leo Fender was good at that. In the mid-'50s he invented the Stratocaster, the Telecaster's three-pick-up cousin. It, too, is still in production, still in great demand. The two designs have been used by artists as diverse as Jimi Hendrix, Eric Clapton and Hank Marvin. Perhaps his greatest invention, however, was the electric bass. When it hit the market, there was technoshock across the bandstands of America. It happened in 1954. Imagine: before then a bass was an enormous upright thing with a baroque headstock and a spike at the other end, played vertically by a person standing alongside it. Fender's model looked a bit like a Telecaster, only with four strings, and was played horizontally, flung around the shoulders, strings facing outwards. The traditional bass relied on its own acoustic properties to make a noise; Fender's used pick-ups and an amplifier.

At first, band leaders and bass players alike greeted it with mirthful

incomprehension. It would never work, they said. Silly idea. In the end, though, band leader Lionel Hampton ordered his bassist to get one. It was a truly cataclysmic move, seen in the light of subsequent developments. The blues had a baby, as Muddy Waters said, and they called it rock 'n' roll, but the baby was born with a Fender bass in its mouth.

Leo Fender died on March 21, 1991. He never did learn to play his own instruments. The Fender bass, with those made by other companies along fundamentally similar lines, is still in production. There have been only three structural changes made to the basic bass design since its invention. All have occurred in recent years, none have been widespread, and, significantly, two have been in response to the revolution occurring in keyboard technologies.

The unrelated development was the design a decade ago by the Steinberger company of the smaller, lighter headless bass. It is popular in some quarters, but not overwhelmingly so. Over the past six or so years, several companies have started producing a bass with five strings. Such a design has always been possible, but only recently deemed necessary. Michael Richardson, of The Bass Player, Australia's only specialist bass retail chain, explained: "It came about because of the development of bass lines done by keyboards. Fender actually introduced a six-string bass in the '60s, but it didn't sell. Then, in the late '70s and early '80s there was a feeling that keyboard basses were threatening to take over.

"It was the same with the drum machine, when that came on the market. Some people said it would be the end of drummers, but in the end it did no harm at all. You can't get the same feel out of a machine. So the answer for the bass was the five-string. It allows players to reach extra notes – to get low Bs and Cs – in the same way that the keyboards can."

Thus, the irony: the keyboardists set out to imitate the bassists, but the bassists ended up copying the keyboardists. The third change is the development of MIDI-bass systems. Discussion of this, however, should properly wait until we get around to discussing MIDI in general. MIDI is the biggest innovation in music since Fender's lump of electrified wood. And it doesn't make a noise. First, though, we should go back a bit, and change instruments.

In a sense, a modern digital synthesiser such as a Synclavier, or its Australian designed cousin the Fairlight CMI, is the ultimate musical instrument. You name it, it can do it. Not only can it create a vast range of sounds, it can also "sample" any sound from the outside world and reproduce it tonally across the whole keyboard. It can modify sounds in any way the operator chooses, loop them, cross-fade them, control other instruments, layer different sounds, store long pieces, simultaneously reproduce several different sounds and rhythms, dump the whole lot onto storage discs, and much, much more.

Such super-synths are awesome machines. The Synclavier, for instance, with a sampling time of about an hour (compared to only seconds or minutes on lesser beasts), can listen to, let's say, the entire first movement of a Grieg piano concerto and then reproduce it exactly. If you want, it can pitch the whole thing up an octave (or down a semi-tone), playing every fourth bar backwards and every ninth at quarter speed, and add a trumpet and cow-bell duet halfway through. No problem. The music goes round and round, and it comes out here.

It is probably true to say that Synclaviers, Fairlights and their ilk represent the zenith in keyboard-based digital technologies. Advances in this area are now generally held to be marginal rather than qualitative: things such as improving memory or portability. This is not to say that qualitative advances in digital sound production are not still to be made, but they lie in other areas. The path that led to the development of digital synthesisers is strange indeed, pock-marked by oddities and failures, beautiful music and engineering breakthroughs.

The first successful digital synthesis of sound occurred at Bell Laboratories in New Jersey, US, in 1957. In 1975, composer Jon Appleton and engineers Sydney Alsonso and Cameron Jones produced the first portable, performance-orientated, keyboard-based digital synth: the first Synclavier. In 1980 the Casio corporation, known previously as a manufacturer of calculators, released the cheap, lightweight, 2.5 octave Casio VL-Tone keyboard, the first of a wide range of synthesisers at varying prices, levels of complexity and aural toleration.

Before all this started to happen, however, the analog synthesiser had to be developed, expanded, marketed and, about now, consigned to quaint obsolescence. Its development was a sometimes logical, sometimes lateral extension of the technologies involved in acoustic pianos, electric pianos, electric organs, magnetic recording tape, and a selection of downright peculiar early electronic instruments.

In this context we need to look at three significant instruments in the other fields, each of which represents an important step towards both the development of sound synthesis, and its acceptance as a musical form. They are the Fender Rhodes electric piano, the Hammond organ, and the Mellotron. Like a traditional piano, the Fender Rhodes works percussively: hammers connected to the keys hit strings which then vibrate, producing sound. Unlike an acoustic model, however, the strings are only a few centimetres long. Magnetic pick-ups change the vibrations into electric currents which are then amplified. Such pianos were first developed in the '20s, and quickly became popular in jazz and, later, rock circles.

The Hammond organ, on the other hand, hasn't any strings at all. It generates its sounds using a tone-wheel principle first developed by Thaddeus Cahill at the turn of the century. (Cahill, incidentally, was also the first person to use the word "synthesis" in relation to music.) Basically, tone-wheel systems utilise rotating alternators which inter-

TIM CLAEYS

The electric guitar hit the market..

sect with electrical circuits and produce oscillations of given tones. These can then be manipulated by the player, adding or subtracting harmonics as desired.

The electric organ had prosaic beginnings. The idea was to build an instrument that could replicate the sound of a traditional church pump-and-pipe organ, while being small enough to fit somewhere less grandiose than a hall of worship. The first on the market was the Rangertone in 1931. Hammond's first model arrived in the stores in 1935 (where it was promptly snapped up by Henry Ford), and quickly made its mark as a well designed and beautiful sounding instrument.

In the '60s and '70s it, too, became popular with rock and jazz "musos," especially when hooked up to a massive Heath-Robinsonesque rotating Lesley speaker box. It can be heard distinctly on hundreds of songs, such as Procul Harem's Whiter Shade of Pale (check those howling waves up the keyboard) and Traffic's I'm A Man, played by the young Stevie Winwood, who still uses one on stage today. The Hammond is one of the loveliest electric instruments ever made.

The Mellotron, though, was a brilliant, tragic, gooney-bird of a thing, hopelessly unreliable, but, nevertheless, the first performance-orientated instrument to use magnetic tape and to work using sounds recorded from outside, rather than generated internally. Introduced in the late '60s, it featured two keyboards, one of which could play across 35 notes any of 18 pre-recorded "voices", in this case recordings of other instruments, held on tape loops inside. It looked weird, and sounded weird, particularly when you used its built-in note bender to alter the sounds.

It immediately became a favourite of "progressive" rock bands such as the Moody Blues, Yes and King Crimson, despite its technical problems. The flutes playing at the end of Led Zeppelin's Stairway To Heaven were produced using a Mellotron. Although the Mellotron was replaced reasonably quickly by the analog synthesiser, it was an important step forward in music technology and, in its use of "real" sounds, a direct precursor of the Fairlight CMI and the Synclavier.

We're about to take a brisk stroll through the world of analog synths, so it's probably an appropriate time to set the distinction between analog and digital, just to make sure we're all on the same path. The word "analog" derives from the same root as "analogy", which is a pretty good image to keep in mind. An analog instrument or recording makes an analogous representation of sound. Thus, the grooves of a vinyl record are full of wobbles and bumps that correspond to the "shape" of the particular piece of music. When a stylus is applied to the record, it recreates the sound from the stored analogy.

Digital things, however, represent music in a series of measured, binary codes: essentially a collection of on-off numerical calculations taken at extremely short intervals. These binary calculations are then read by a sensing device, and turned into sound by a digital-to-analog converter.

One of the first analog synthesisers was made by RCA in 1957 for the newly established Columbia-Princeton Electronic Music Centre. Two years later the company donated an improved version, the RCA II. It was an enormously cumbersome thing contained in several huge cabinets and, by today's standards, extremely limited in its capabilities. It could, for instance, only manage two notes at a time.

It was, however, very popular with Milton Babbitt, one of the most important pioneers of computer music composition. The centre was used in later years by many other experimental composers, including Edgar Varese, Jon Appleton, and Wendy (then still Walter) Carlos. Carlos, incidentally, produced the first big-selling album of completely synthesised music: Switched On Bach, in 1968. She played it on a Moog synth, the first brand to go into commercial production two years earlier.

Its inventor, Robert Moog, was perhaps the synthesiser equivalent of Leo Fender. A physicist from New York, he started his musical career in 1963 by selling owner-built theremins. After developing his first successful studio synthesiser he went on to design the MiniMoog, a monophonic performance model that quickly became the favourite of rock musicians and stayed in production until the early '80s. He also came up with the PolyMoog in 1975, the first synth to use preset as well as programmable sounds, and many other models, including one that could be played with the feet, and one that could be slung around the shoulder like a guitar.

During the '70s, synthesiser music was no longer a curiosity or restricted to the avant garde. It was the dominant occupant of the mainstream, so much so that it prompted an angry, primitivist (and necessary) counter-reaction in the form of punk music. Which brings us to the digitals. Here we need to quickly become familiar with three procedures to understand the basic terms of reference within the field. These are: sampling, sequencing and MIDI.

Sampling is the process by which sounds and noises produced independently of a synth are recorded digitally, and then incorporated – pristine or modified – into a larger piece of music. Although sampling on commercial records goes back at least as far as Kate Bush's Army Dreamers, its most popular and controversial use today is within house and rap music, where phrases and key signatures of other songs are "pirated" and used in a fresh context.

Sequencing is the process by which computer-controlled instruments can be made to play certain pre-programmed arrangements independently of the performer. This typically allows whole pieces to be played without the need, say, for a human rhythm section or multitrack recording.

And then there is MIDI. The acronym stands for Musical Instrument Digital Interface. Much has been written about MIDI, and almost all of it confuses musicians and non-musicians alike. But basically MIDI is a standardised system which allows otherwise incompatible instruments to "talk" to each other. At its simplest, MIDI permits a master-slave relationship between two synths, the master triggering required passages or functions as the present program requires.

MIDI is a growth area in music. The system is forever being refined and made more versatile. It is being introduced into guitars, bass guitars, drums, foot pedals and more. To a large extent, it has redefined the traditional one-to-one relationship between musician and instrument.

Since their introduction, digital synthesisers, in common with many other types of digital technology, have increased rapidly in quality and decreased just as rapidly in price. This process has been so dramatic, in fact, that the original studio-based Fairlight CMI and Synclavier (although not the new models) look pretty limited in comparison to even middle of the range on-stage models by Yamaha, Episoniq, Roland or the other manufacturers.

and music has never been the same

Digital synths have several advantages over analog models, including crisper, cleaner sound quality. They are also able to construct waveforms to the exact specifications of the performer, store information on disc, and manipulate real-life samples. Dr Jeff Pressing is a lecturer in contemporary music at Latrobe University in Melbourne. His department runs a year-long post-graduate course in computer generated music.

"Digital synthesisers have brought about fundamental technological changes," he said. "Together with the development of multi-track studios they have brought about big changes, particularly in editing. With analog synthesisers, editing had its limitations: if you had bad inputs, you were going to have bad outputs. With digital, you can be an aural microsurgeon, if you like."

The sequencing potential of digital synthesisers has changed the nature of composition in many areas, allowing one musician to do the work of many. The results of this process are sometimes startlingly good, such as in the work of artists such as Yello, Phillip Glass and Laurie Anderson.

Peter Johnson is a composer of electronic music, and long-time presenter of one of the few regular radio programmes dedicated to the form, The Electronic Influence, aired on Melbourne's 3PBS. Unlike many enthusiasts, Johnson was slow to switch from analog to digital. "The early digital synths sounded very cold," he said, "So I converted to digitals only a few years ago when the Korg M1 was released. It has a much warmer sound, something really fresh.

"The advantage of digitals is that they speak a much larger language to computers, sequencers and so on, though MIDI. Sequencers are good because they free up the musician. If you listen to Rick Wakeman's early albums, for instance, it seemed like he had eight or nine hands. Now, sequencers could take over the more mundane pieces of music – slow, repetitive bass lines, for instance, or certain underlying rhythms. Sequencers are just like partners, really."

Which probably makes Rick Wakeman, an alumnus of the Mellotron-burdened Yes, feel rather depressed. His multi-keyboard compositions, such as The Six Wives of Henry VIII, or Journey To the Centre Of the Earth, were as much feats of manual dexterity as they were musical milestones. It also probably makes Michael Richardson of The Bass Player a little miffed, given that slow, repetitive basslines are a painstakingly learned part of his repertoire. Even if we accept the contention that keyboard-based digital synths have reached their optimum developmental limits, this does not mean that developments in other areas of digitised music-making are not possible. A lot of work is underway on what the jargonists call the "user interface", or, more prosaically, how you play the damn things.

On a practical level, this entails a lot of work on making programming easier, for instance in the area of on-screen manipulation of waveforms and compositional notation. Within the avant garde, however, some of the research seems positively bizarre. There is, for instance, the work of Michael Gogins of Brooklyn, whose interest is in fractal music. According to MIT, he is searching for "a universal compositional algorithm with a coherent parametric map." In other words, he's trying to find a musical Mandelbrot set. If he is successful, he will probably discover a form of music that goes round and round in ever decreasing circles.

Then there are Hugh Lusted and Ben Knapp of the American concern, BioControl. They've developed the BioMuse system. The MIT publication, Computer Music Journal, described its use at the Cyber Arts International Conference held in September 1990: "The BioMuse system was used for intricate control of a MIDI synthesiser, with arm muscle tension controlling pitch, eye motion controlling panning, and brain state controlling timbre."

At last: the sound of one mind boggling. Music listening, a well as music making, has been revolutionised by digital technology. Since its introduction, the compact disc has increased its market share to the point where it is now almost the dominant format. Australian CD maker Disctronics expect the CD to increase sales by a further 20 per cent this year, while cassette tapes remain stable and the dear old vinyl album shrivels to almost nothing. Contrary to predictions, however, it is unlikely that vinyl recordings will ever completely disappear. There is a significant section of the audiophile market that maintains that vinyl produces a preferable, warmer sound than CDs. The compact disc is a technological form most certainly not at its optimum developmental level. Since its commercial introduction in 1982, work has been going on at a furious pace to improve it and expand its potential.

A lot of effort, for instance, is going on in the development of two new formats: CD-WORM (write once/read many), and CD-WM (write many). Among many other applications, musical and otherwise, WORM and WM will make home recording on CD as feasible as it now is using cassettes. A production model CD-WORM machine is expected on the market by 1993. Cost at the moment would be around $US35,000, but that is certain to drop enormously over time.

Work is also well under way on CD formats able to store video as well as audio information, known variously as CD-I, CD-V, and CD-G. The Commodore company has already launched CDTV in America: audio-visual CD recordings of, among other things, the complete works of Shakespeare, the Bible, and a world atlas.

Challenging the CD's status as the best digital recording method are two other formats: DAT (digital audio tape) and DCC (digital compact cassette). The first is championed mainly by Sony, the second by Tandy and Phillips. DAT has been available in Japan since 1990, and has been used for a while in other countries as a professional recording medium. KLF, for instance, the British pop duo, recorded their 1990 hit album Chill Out using two DAT recorders. Sony introduced the first portable, personal DAT player – the TCD-D3 DAT Walkman – on the Japanese market this year.

So far, both DAT and DCC (basically the same as DAT, but shaped like a conventional cassette and requiring a slightly simpler playback mechanism) have failed to make a huge foray into the consumer market. There are two factors.

First, regardless of recording quality, digital tape still requires mechanical fast-forward and rewind functions, as distinct from the CD's push-button immediacy.

Second, the development of the formats have led to legal challenges and boycotts by recording artists and their professional bodies, amid fears that the tape's faultless non-degenerative recording capability will lead to widespread piracy. As a result, both DAT and DCC now incorporate Serial Copy Management Systems (SCMS), which, while permitting users to make a first generation CD-to-tape recording, will prevent subsequent digital-to-digital transfers using the first generation copy.

A lot of work is also being done on increasing the compatibility between various audio and video formats. The new AIWA MMD-100 DAT recorder, for instance, can accept signals from video camera, camcorder, satellite and cable, VCR, videodisc, microphone, cassette, CD and others.

All of which will no doubt lead to a quantum leap in both professional music generation and the design of home entertainment systems. Meanwhile, somewhere a way back down the technological evolutionary path, however, this reporter is still trying to figure out the remote control on the stereo. The music goes round and round, but getting it out is sometimes the hard part.

Andrew Masterson is a freelance journalist based in Melbourne.

Art's subtle invaders

Australians have the reputation in parts of Asia of being uncaring and undiplomatic. Now a group of artists is rapidly improving that image, replacing the brash with the brush

BY ALISON CARROLL

What do people in Asia think of Australian art? If they think about it at all, they would be likely to think of displaced European images, or images of the outback with koalas and kangaroos. People who have been in New York recently would perhaps also think of Aboriginal art.

But what happens if works of Australian art actually are displayed in Asia? Recently, in Bangkok, a large sculpture called Boat, made of gum tree twigs, cotton cloth, bitumen and string was put on display in the National Gallery of Thailand. Reproductions of it appeared in most of the 30 newspaper stories on the exhibition. Two large hand-painted reproductions were displayed in the major square of downtown Bangkok. Collectors wanted to buy it, and visitors said how much they "loved" it. Melbourne sculptor John Davis, who made the work in a little workshop in suburban Mordialloc, was in Bangkok for the opening of the exhibition. He was interviewed on TV and radio and probably was the best-known artist in this city of nine million people for a time. John has subsequently organised an exhibition of Thai contemporary art to appear at Melbourne's International Festival.

Boat was part of a large exhibition, called Art from Australia: Eight Contemporary Views, which has just toured South East Asia. Two photographers with work in this exhibition, Anne Ferran and Fiona Hall, both addressed local art audiences, in Manila and Jakarta, and were often asked how they had made their images. Anne and Fiona are both involved in possible ventures with the Philippines and Indonesia. Sydney artist John Young and critic Christina Davidson, in Singapore for the opening of Eight Views, interviewed local Singaporean artists about their work, immediately creating sympathy between the visitors and their hosts, and the resulting links are continuing.

Joan Grounds, a Sydney sculptor, spent four months in Bangkok as the first recipient of the Australia Council's programme developing 'residencies' with art schools in South East Asia. She learnt Thai each day and she made close friends among the artistic community. She held an exhibition as Silpakorn University at the end of her stay. She has since been asked to teach at Chiang Mai University in Northern Thailand, a position she filled after some months in Paris. The next Australian to go to Bangkok for this residency is Noelene Lucas.

In neighbouring countries, Australian artists have also made an impact. A one-day workshop in Vientiane, Laos, by one batik artist is still talked about a year later.

Anne Ferran *Scenes on the Death of Nature 1*
1986 silver gelatin print 122cm by 167cm

Fiona Hall *Illustration to Dante's Divine Comedy* 1988 polaroid print 88cm by 66cm

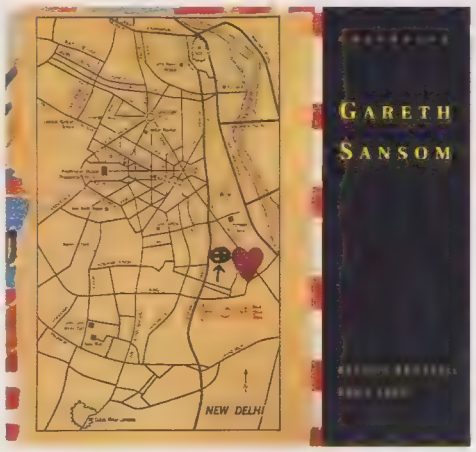
John Davis *Boat* 1990
Eucalyptus twigs, cotton, bituminous paint, string 2m by 4.5m

Noelene Lucas
River with sun and moon 1990
marble, steel, burnt wood and seashells
7.5m by 1.5m

Gareth Sansom, who until recently was Dean of the Art School of the Victorian College of the Arts, was chosen to represent Australia at the last Indian Triennial. He spent four months working in Delhi, making images which were included in the Indian, and subsequent Australian, exhibitions. His work makes obvious reference to the new life around him.

These exhibitions and visits have been remarkable not only for their success but because they are so rare. Slowly, the obvious links and interests of Australian and Asian artists are made, and with time and increasing contact, strengthened. Gradually the ignorance and hostility between both sides are overcome.

Most people hold on to the easy view. It's convenient to think of Asia as Third World and it remains very threatening to some Australians to treat Asians in a different, equal way. For the increasingly affluent Asian countries, there is firstly surprise that there is cultural material from Australia, and secondly that it may be interesting.



Catalogue of Gareth Sansom's work for India

If you are a Singaporean, you are more likely to travel to London than to Sydney to see an art exhibition or performance, because you have grown up thinking that London offers a better product. Equally if you are Filipino you are more likely to do your post-graduate studies at an art school in America than in Australia, because you know nothing of Australian education systems or Australian art, and because your lecturer studied in America it must be best.

The Eight Views exhibition was reviewed in Manila by a Filipino artist who had been to school in Sydney. He regretted the passing of the Australian pastoral tradition. He felt nostalgic for the easy-going, relaxed, parochial culture he remembered, and only in his mind accepted that our art is as internationally based as that of New York, or indeed of his own country.

Asialink, a non-profit organisation set up by the Commission for the Future, the Asian Studies Council and the Myer Foundation, and now affiliated with the University of Melbourne, has a new program to encourage and facilitate more exhibitions of Australian art and craft in Asia. The program has seeding funding from the Department of Foreign Affairs and Trade, and the Australia Council. So far, the response from Australian artists, curators and administrators has been very positive. More Australians see the sense of getting to know more about Asia and vice versa, and want to put that into tangible form.

Developing countries and women are seen as the lucrative growth markets

Where does t

About 50 million people in China are destined to die prematurely, not from flood or famine or civil unrest, but from a preventable yet still spreading epidemic: smoking. And in the West, the carnage continues

BY PHILIPPA HAWKER

When Sigmund Freud urged his nephew Harry to smoke, he told him: "My boy, smoking is one of the greatest and cheapest enjoyments in life, and if you decide in advance not to smoke, I can only feel sorry for you." Nevertheless, the 17-year-old refused his uncle's offer. That was in the 1890s, when Freud was struggling with a smoking habit that he was prepared to call an addiction. Now, in the 1990s, smokers can still urge non-smokers to take up the habit, or put pressure on fellow-smokers not to quit. But the agenda has changed dramatically.

As well as health issues, there are economic, social and civil rights considerations which play a part in the debate on smoking. And the awareness of passive smoking – the evidence that non-smokers in a smoker's environment can be affected by an activity they do not actually engage in – has significantly altered public and government attitude towards tobacco.

In Australia, the Morling decision has been a landmark. In February 1991, Justice Trevor Morling of the Federal Court handed down a ruling on involuntary passive smoking, concluding that "there is compelling scientific evidence that cigarette smoke causes lung cancer in non-smokers." The ruling will make it easier for an employee to mount a case against an employer, and can be expected to encourage the adoption of more smoke-free working environments. Regulation of the smoking habit was once confined to controls on advertising and sales to minors: a ban on cigarette advertising on television and radio was introduced in 1976, and it is now banned in the print media. States have additional bans on billboards, cinema advertisements and the distribution of free samples.

Advertising had been an important part of the budget of the three major tobacco companies operating in Australia – Philip Morris, Rothman's and W.D. & H.O. Wills – which spent about $68 million on media advertising in 1988. As the marketing avenues were closed, sponsorship became, and still is, a way of getting a message to the public. Sports and arts sponsorship. Benson & Hedges has spent more than $50 million on cricket. The government response has been the establishment of health promotion foundations to provide alternative funds for sponsorship: the Victorian Health Promotion Foundation

received $31.2 million in 1990-91, while South Australia's Foundation SA received $8.9 million.

Advertising bans have finally been accompanied by bans on smoking itself. It is not allowed on public transport and in government buildings, and workplaces are starting to become smoke-free environments. How much further can it go? Will smoking be the ultimate taboo activity, permissible only in the privacy of the home, and only in the company of consenting adults?

Writer and humorist Garrison Keillor indulges in a fantasy about a world that casts out smokers; in his story *End of the Trail,* they become outlaws who choose to give up homes, jobs and families rather than renounce tobacco. The story begins: "The last cigarette smokers in America were located in a box canyon south of Donner Pass in the High Sierras by two federal tobacco agents in a helicopter who spotted the little smoke puffs just before noon. There were three females and two males, all in their mid-forties. They had been on the run since the adoption of the Twenty-eighth amendment".

Sponsorship of all kinds

Keillor's story is a comedy with a twist in its tail, but it captures the sense of the smoker as outsider. There are those who argue that the anti-smoking lobby stigmatises the individual: heavy-handed treatment of the issue can drive incorrigible smokers to band together, and there is a danger of reinforcement in strategies which treat smoking as an addiction.

In the past, government policy towards the tobacco industry echoed the words of France's Napoleon III: "This vice brings in one hundred million francs in taxes every year. I will certainly forbid it at once – as soon as you can name a virtue that brings in as much revenue."

Since 1980, there have been at least 10 cases in which employees have received compensation and/or settlement cash for claims or injuries related to passive smoking. When workplaces are made smoke-free, there is often a place provided where those who wish to continue to smoke can do so. However, in Victoria, for example, it seems that permanent or long-term provision of designated smoking areas does not satisfy an employer's duty under the provisions of the Occupational Health and Safety Act. This will need to be taken into account by those advocating "smoking" and "non smoking" areas in restaurants and places of entertainment.

Smoking bans are more widespread, and information on the health risks of smoking is now easily available. But what impact does information and advice have on people's decision to quit the habit, or continue? Once again, it is interesting to consider the case of Freud, who was advised in the early 1890s to give up smoking by his friend and colleague Wilhelm Fliess, an ear, nose and throat specialist. But Freud said despairingly that he could not: he claimed that his capacity for work and self-control was improved by this "habit or vice", as he called it. Freud's father was a smoker, and Freud's circle all indulged. He held weekly gatherings at his house; his son, Martin Freud, observed that some hours after the meetings had ended, "the room was still thick with smoke and it seemed to me a wonder that human beings had been able to live in it for hours, let alone speak in it without choking."

Even when he developed mouth cancer, Freud continued to smoke cigars. He told Fliess that addictions – and he included addiction to tobacco – were substitutes for "the single great habit, the 'primal

he butt stop?

Tobacco is a substantial industry and source of government revenue. The value of retail sales in the tobacco industry has increased from $1886 million in 1983-81 to $4014 million in 1989-90. Government revenue from tobacco smoking in the 1980s, which incorporated a federal excise and a state licence fee, has risen at the same time from $933 million to $2088 million. The budget estimate for 1990-91 is $2339 million. But there are other figures to be taken into consideration. It has been estimated that smoking costs the Australian community a far greater amount in lives, hospital treatment and absenteeism. A 1991 report estimated that it cost the Australian economy $6.8 billion each year.

The tobacco industry is on notice that the market is expected to contract. So what happens now? In the 1970s, tobacco companies recognised that passive smoking was going to have a significant impact on the industry, and we are just beginning to feel its impact in compensation and equal opportunity cases.

With this smoke ring . . .

Passive smoking is the involuntary or second-hand inhalation of smoke, usually in an enclosed space. It can be inhaled directly from a cigarette being smoked nearby, or indirectly from a build-up of smoke in the environment. It has been estimated that 146 Australians die each year from lung cancer caused by passive smoking, and it has been been legally and medically defined as a hazard to health in the workplace. A British study estimated that non-smokers in a typical enclosed office inhaled the equivalent of five cigarettes a day.

addiction' of masturbation." But he did not develop this observation into a paper, and he did not give up tobacco.

He knew very well that he should do so: he was advised to by several physicians. These days, the evidence against smoking is very strong: those who choose to continue smoking do so with at least some consciousness of the health risks associated with the activity. Some groups have more information than others. There has been a strong argument that advertising played an important part in people's decisions to take up smoking. Can it play a similar role in getting people to quit? And what strategies can be used to discourage people from taking it up in the first place?

Details about the ingredients of the cigarette are now well known. When you smoke you inhale up to 4000 chemicals, including hydrogen cyanide, methanol, arsenic, butane, carbon monoxide, naphthalene, and DDT.

Nicotine is the addictive element in tobacco: physiologically, it increases heart rate and blood pressure, and constricts the cutaneous blood vessels. It takes only six seconds to reach the brain. Nicotine is highly toxic, and its manufacture, use and sale is controlled by the State Poisons Act except where it occurs in tobacco products. Nicotine chewing gum, an aid to giving up smoking, is a restricted product, sometimes available only on prescription, and all other forms of nicotine come under the schedules of the act which

apply to exceptionally poisonous substances or insecticides. Tar, the cancer-carrying agent, is the substance inhaled when a smoker draws on a lighted cigarette. The tar content in cigarettes available in Australia has fallen substantially since 1969.

Because of the perceived importance of cigarette advertising, if could be assumed that an advertising campaign against smoking could be equally effective. This is not the case: as a report to the 15th International Cancer Congress points out, health advertising "always seeks to reverse a dangerous behaviour that is often habitual and positively reinforced. The target audience may not even be interested in hearing the health message, let alone in complying with its advice." The report's authors, David Hill, Michelle Scollo, Sue Noy and Dorothy Reading, also consider the apparently irrational behaviour of people who continue to smoke, even when presented with medical evidence that it is a harmful activity. They say that this is not irrational: people "almost always act rationally in terms of the following: all the information they have available to them; the construction they put on that information; their own hierarchy of values; their real and perceived capacity to act on the advice we give them; and the cultural norms and expectations of their own particular social (sub-cultural) environment." What research needs to establish is the different reasons why people choose to take up or continue smoking.

Nicotine is a highly addictive substance. But it is not simply its addictive properties that are important. The speed of its action and the high frequency of inhalation mean that smoking is an "over-learned" behaviour. The rituals associated with having a cigarette help to reinforce the importance of the activity to smokers. In fact, highlighting the addictive nature of nicotine may not be a deterrent to smokers. It is possible that to an entrenched smoker, the notion of addiction may be a justification for the habit, and a reinforcement of a perception that giving it up is not possible.

JAMES BODDINGTON

Ritual for a monk

The pleasures of tobacco are often mentioned, but there is differing evidence on this. A recent study conducted in the Northern Territory indicated that pleasure was given by smokers as a major reason for their habit, yet in an earlier survey on Australian patterns of smoking and related health beliefs, for example, only one per cent of current smokers mentioned loss of the enjoyment of smoking as a disadvantage of giving up. One quarter of that sample believed smoking actually ameliorates some health problems, and nerves (18 per cent) was the most often mentioned.

Dr Bobbie Jacobson, author of several books on women and smoking, believes that women, more often than men, use smoking to relieve stress: rather than tackling the source of the stress or anxiety, they internalise it through smoking. This is one of the reasons for smoking that cannot be tackled simply by emphasising the health risks posed by tobacco. It is evident that women are not giving up smoking to the same degree that men are, and that young girls are more inclined to take it up than young boys. Australian figures show that 16-year-olds smoke about the same level as adults, with more girls smoking than boys. There has been a considerable decline in male smoking rates – in Australia, smoking by men has more than halved since 1945. But smoking by women has remained stable.

Clearly, anti-smoking campaigns need to find a way of addressing women. There is some disagreement about the best way to achieve this. One example is some advertising material prepared for the Victorian Quit campaign, which was designed to be inserted in women's magazines: it uses the language and tone of its location. "Why make smoking part of your makeup?" one leaflet asks: it depicts an attractive young woman who looks like a model and brandishes blusher, eye pencil and mascara, rather than an Alpine. The leaflet is headed Fitness and Appearance, but It focuses on the latter, warning that toxins in cigarette smoke reduce circulation to the skin, causing a sallow complexion, wrinkles, and leathery, prematurely aged skin. The leaflet continues: "Next time you see an older woman who smokes, take a good look at her face. It's not a pretty picture."

As the campaign to persuade smokers to cut back or cut out their habit grows – in the US, Europe and Australia – tobacco companies are looking for other markets: Asia is still lucrative. Rothman's is expecting Papua New Guinea, Fiji, Indonesia and the Philippines to be growth areas in the next few years. The biggest potential market of the future, however, is China.

The tobacco tax is China's second-biggest source of revenue, and there is very little incentive not to smoke: local brands are cheap, and health warnings are not widely sounded. Given that the warnings about smoking in the West were widely sounded in the 1950s but took years to have any significant impact on smoking habits, what does this mean for the Chinese market?

Half of China's population is under 25, and this is the age group that is taking up smoking. A significant proportion of Chinese, as high as 75 per cent, it has been estimated, are smokers. If Chinese women start to follow Western patterns, the public health costs in the longer term could be overwhelming. Fifty million will eventually be killed by the habit. In Taiwan, the tobacco market was opened up in 1987 with the number of US cigarettes sold in the first year of deregulation increasing 24-fold.

In the new China, expensive Western brands of cigarette are potent symbols of sophistication, even if they cost about a third of the average weekly income. There is a high recognition of these brands: Marlboro Man has conquered here already. The irony is that Western consumers are more likely to be giving up cigarettes, but the image in China of smoking is of a glamorous activity pursued by the young and affluent Westerners.

The health risks associated with smoking are not always relevant in countries where the average life expectancy is 25 years than it is in the West. In the Third World, tobacco competes directly with food as an item to be purchased, as well as grown. The return per hectare for tobacco may be five times that of maize, and three times that of groundnuts. It is a profitable crop for farmers even in countries which are short of food.

The other aspects of concern is the environmental damage. Tobacco depletes soil nutrients at a higher rate than any other crops. This requires the use of fertiliser, which adds to the cost of production: growers who cannot afford this tend to exhaust the soil quickly and deforest new areas to plant new crops. Tobacco also requires heavy use of pesticides and herbicides.

In countries like Brazil, India, the Philippines, Thailand and most of Africa, the tobacco crop is cured with wood fuel. It has been calculated that this requires one tree for every 300 cigarettes produced, or that the production of a one hectare crop of tobacco each year requires the destruction of an equal area of forest.

Philippa Hawker is a freelance journalist based in Melbourne.

FISH

LORRI GRAHAM

The chips are down

It may not be long before the trendy, tender types of fish so popular with diners today are rubbed off restaurant blackboards for good

BY MARY-LOU CONSIDINE

Can eating a humble piece of flake be compared to eating a venison steak or a haunch of wild boar? Some conservationists argue that our generation may be the last to have the privilege of eating cheap game meat from animals that live and reproduce as they have done for millenia – the wild animals of the sea.

Modern fishing technologies have made man a deadly predator, not just of individuals, but of whole species. Unlike game animals which are hunted and killed with simple weapons like rifles, fish are hunted and killed on a large scale, using technologies that are so accurate and efficient that fish are being tracked down and taken faster than they can replace themselves.

Fish do not have the endearing qualities of a panda and their habitats don't offer the mist-shrouded beauty of a rainforest. They are slimy and decidedly uncuddly and the wilderness they inhabit is wet, cold and uninviting. So when it comes to the issues of conservation and sutainable development, they tend to miss out on public concern. But Australians cannot afford to ignore their fisheries resources for much longer. Right now, scientists around the country are calling for much tighter restrictions on commercial fishing. Their research indicates we may have overstepped the limits of sustainable harvesting.

The fishing industry, on the other hand, is not convinced. It claims that many of its problems have been caused by fragmented and contradictory management of the resource divided as it is between State and Commonwealth Governments – and that scientists' predictions are unreliable.

OFF THE MENU

Is there cause for concern? The plight of a couple of our most popular seafood items, flake and orange roughy, highlights some of the issues. Flake is the meat from two species of sharks – the gummy shark and the school shark. These sharks sustain a fishery that extends from eastern Victoria, south to the waters off Tasmania, then west to the western boundary of South Australia.

Like most other Australian fisheries, the southern shark fishery enjoyed an initial boom phase that, decades later, has slowed down. In recent years, shark fishermen have been able to use new techniques for increasing their total catch, but the catch yielded per unit effort on the part of fishermen has been declining. In other words, they are having to pedal faster just to keep up.

Scientists have long been concerned about overfishing. Research on the biology of the sharks has shown that both species are relatively long-lived and produce few offspring, leading scientists to conclude that stocks are not as rapidly replenished as shorter-lived marine species such as prawns.

Consequently, the Federal Government's Department of Primary Industries is trying to encourage the southern shark fishery to reduce its catch, placing restrictions on the number of nets that fishermen can use. The aim is to reduce the annual catch from 3500 tonnes to somewhere between 500 and 800 tonnes.

Shark fishermen are not happy about conforming to restrictions based on research results that they believe to be imprecise and inaccurate. Imprecision is a universal problem for marine biologists. Unlike land animals, fish can't be easily observed, counted and followed. The methods that scientists use to estimate a marine species' abundance, growth rate, life span and breeding rate involve indirect measurements and some "guesstimates".

Unlike land animals. fish can't be easily observed, counted and followed

But as Dr Phil Sluczanowski of the South Australian Department of Fisheries points out, scientists' predictions, even though they may not be completely accurate, are better than nothing. We can only base our predictions on the best available information, says Dr Sluczanowski. Uncertainty will always be there. But fisheries managers and fishermen have to weigh up the consequences of taking action and being wrong, against the consequences of taking no action.

Dr Sluczanowski and his colleagues have developed a sophisticated computer model, SharkSim, which simulates the effects of different fishing techniques on the age structure and reproduction rate of the fish population and on the catches and catch rates of the fishery.

The model combines the results of more than 40 years of research into growth, density, mortality, reproduction, catchability, selectivity and fishing statistics. It offers scientists and managers a window onto the future, mapping out the consequences of various policies and regulations in terms of their impact on the catch.

The pictures that the model paints are not comforting. Taking the case of the most severe remedial action, immediate closure of the fishery. It would take 15 years for stocks to return to a level at which they could be fished indefinitely. If the annual catch was limited to 800 tonnes, the fishery could survive for 15 years and then collapse. Total collapse could be avoided if the fishery was to be immediately closed for one year to allow stocks to recover.

Delayed action, while fishermen demand more accurate data or while management bodies avoid making tough decisions about restrictions, seems to be the current response. According to the model, delay will only compound the damage, putting the prospect of recovery even further into the future.

Effective communication between scientists and the fishing industry is a major barrier to getting agreement on appropriate action from the different interest groups, according to Dr Sluczanowski. Scientists have to wear some of the blame; their research results tend to be buried in academic journals, and the limitations of their data are often not adequately explained to non-scientists.

SharkSim provides a ray of hope, allowing users to view the effect of different management strategies such as the use of fewer nets. With its arresting colour displays, SharkSim can graphically convey the consequences of inaction to fishermen and fisheries managers. In fact, SharkSim and its relatives – AbaSim, an abalone fishery simulation package and PRAna, a tool for estimating recruitment to fish stocks – may eventually be applied to other fisheries as a way of communicating research findings to managers and operators.

If the shark fishery eventually fails, we may have to look at alternatives for ever-popular flake. One suggestion has been to import hake from overseas, but as Dr Sluczanowski points out, fisheries overseas are facing the same crisis as those in Australia. There is no doubt though that, for the consumer, the loss of local fisheries like the southern shark would mean an increase in the retail price of fish.

DIGGING DEEP

Demonstrating the outcomes of present management strategies may not be enough to convince fishermen. As small business managers, their major concern is the present, not the problems that might arise in 15 years.

Like most fisheries in Australia, the shark fishery mainly involves individual operators, each having a considerable investment tied up in their boat and associated navigational and fishing equipment. With this investment at stake, they have little incentive to become less productive and lose revenue. So they will continue to do what they have done for years – work their gear as hard as they can.

The Commonwealth Government is aware that we have too many players in all our commercial fisheries, but rationalisation is a process that involves putting people out of work, not an easy decision to make.

One fishery undergoing a major restructure is the northern prawn fishery. The restructure will cut the number of fishing vessels operating in the fishery by half. Many boats have already been removed, and the owners compensated for their loss.

The Government sees subsidised withdrawl, with a system called "individual transferable quotas" (ITQs), as the most effective means of protecting our dwindling fisheries resources. ITQs may provide a means of establishing ownership rights over fisheries because, as they stand, fisheries belong to nobody, so nobody is responsible.

But will managers get the right strategies in place in time to save valuable species like the orange roughy? Orange roughy was a bit of a stranger to Australian palates 10 years ago. In recent years, our appetite for the fish, and the price it commands in export markets, has had fishermen rushing to "hot spots" off the Tasmanian coast to take part in a fishery worth about $50 million a year.

After 1985, when the first catches were made, the fishing industry moved fast to exploit the resource, with new entrants investing in special acoustic sounding and trawling equipment to work the deep sea floor on which the fish lives, more than 1000 metres down. Navigational and depth-sounding equipment enabled fishermen to zero in on the large spawning aggregations that occur off the Tasmanian coast during breeding periods, making for a good and easy catch.

But the bumper harvests of the mid to late '80s cannot last. CSIRO research on the fishery has shown orange roughy to be extremely long-lived. Their life span is comparable to that of human beings – about 70 to 80 years (the oldest known specimen is 149 years old). They breed later than humans, at about 32 years of age.

Obviously, a fish that takes so long to grow and reproduce will not sustain intensive commercial fishery. CSIRO scientists have warned the industry that it has to reduce its total allowable catch from 12000 tonnes to 2700 tonnes for this valuable fishery to last.

WORKING SMARTER NOT HARDER

The problems faced by the orange roughy and southern shark fisheries – overexploitation of stocks, improvements in efficiency resulting from new techniques and technologies, and excessive exploitation of newly-identified resources – are repeated elsewhere in Australia. The prognosis for the southern blue-fin tuna fishery, for example, is even worse than that of the shark fishery.

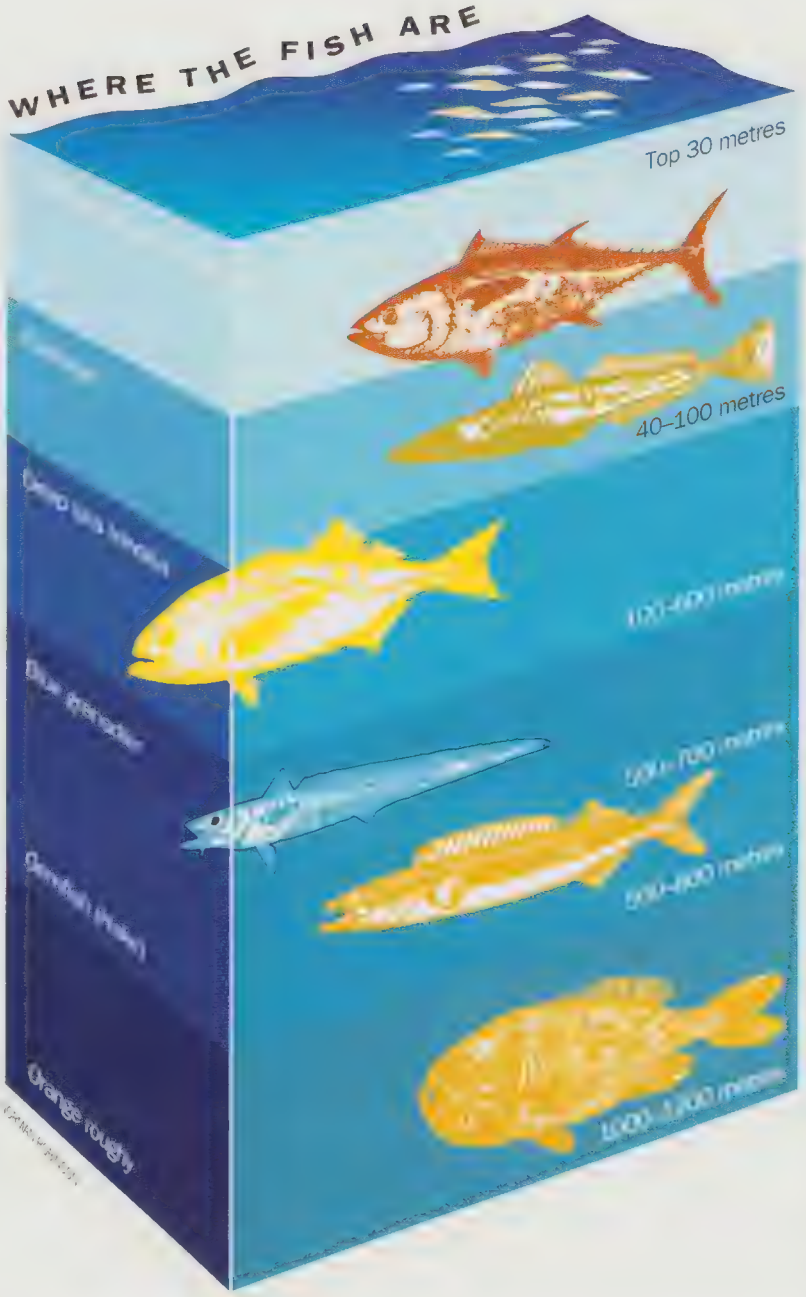
Apart from better management of the fisheries, there are other ways to reduce our "predation pressure" on wild fish stocks. Aquaculture – the intensive farming of shellfish and fish – is one means. Australia's past efforts here have concentrated on oysters and salmon trout. Researchers are now looking at other aquaculture prospects such as prawns, shellfish other than oysters, and fin fish.

But the most promising avenue for making more productive use of our catch at the moment is in value-adding, through better post-harvest processing and marketing. Tuna is a good example. As mentioned earlier, one of our tuna fisheries has already suffered excessive levels of fishing.

Much of the Australian tuna catch ended up in tins. The irony is that Australian cats were eating fish that could fetch $75 per kilo in the Japanese raw fish or sashimi market. Now, in Queensland, researchers and marketers are looking at ways of adding value to fisheries products like tuna to cash in on lucrative export markets.

At the International Food Institute of Queensland, a team of seafood technologists, microbiologists and marketing consultants has found a way of processing and presenting longtail tuna, traditionally considered a low-grade tuna, for the Japanese market.

Instead of sending the whole fish, they select the choice cuts or "loins"; these fillets are then vacuum-packed to enhance the colour of the meat (red is desired for sashimi) then air-freighted to Japan. The response of Japanese buyers has been promising and an added bonus is the 50 percent reduction in freight costs.



Another success story is the Japanese king prawn project. The Institute set up a joint venture with a private prawn farm to produce live prawns for the Japanese market. The research component involved finding optimal temperatures for transporting the prawns, and identifying a suitable support medium – sawdust – in which to pack them. The first commercial shipments of the live prawns have proved a success, fetching up to $80 a kilo in Japan with a 95-100 percent survival rate for the prawns.

Work is continuing on a number of other projects, including spanner crabs and brown tiger prawns. Institute researchers plan to apply their expertise in the transport of live crustaceans to both these species. The point is that we don't have to take more fish out of our waters to increase or maintain the value of our fisheries. As with every other industry today, the choice does not have to be working harder, but working smarter.

AT THE END OF THE DRAIN

Through its sustainable development initiatives, the Government is taking a broader approach to the preservation of our fisheries. Sustainable development is not just about commercial fishing, says Dr Murray Johns, Executive Officer of the Commonwealth Government's Sustainable Working Group on Fisheries. The management of our fisheries resources has to take into account tourism, recreational fishing, conservation of species and protection of the environment. With a renewable natural resource, you can only live off the interest; if you start living off the capital, you run the resource down, leaving nothing for future generations.

Recreational fishing can have a significant impact on commercial fisheries. Surveys of some fishing spots have shown that the recreational catch can be up to 20 times the commercial catch. "As Australians, we all believe we have a right to catch a fish whenever we want", continues Dr Johns. "Yet we can't just go out and cut down a tree in a state forest".

Pollution and habitat degradation also have an impact. Industrial waste is one well-known source, but another important problem is resort and marina development, particularly along the coast adjacent to Queensland's Great Barrier Reef where mud flats (a favourite nursery for many fish and crustaceans) have been destroyed for recreational or urban development.

Fisheries are located "at the end of the drain", says Dr Johns. The waste and fallout from poor agricultural practices, urban development, factories and resorts all run downhill ... and end up in the ocean.

Mary-Lou Considine, a science graduate with experience in marine biology, is a freelance journalist based in Melbourne.

AUSTRALIA'S TH

The conservation status of Australian fish was classified by the conference on Australian threatened fishes held by the Australian Society for Fish Biology in Melbourne in 1985. Fifty-nine species were listed in seven categories. Revisions of the listing followed in 1988 and 1989. This listing is from the 1990 supplement and it deals with the three most relevant categories.

ENDANGERED

Swan galaxias
Galaxias fontanus

barred galaxias
Galaxias fuscus

Clarence galaxias
Galaxias johnstoni

Pedder galaxias
Galaxias pedderensis

trout cod
Maccullochella macquariensis

eastern freshwater cod
Maccullochella n.sp.

Lake Eacham rainbowfish
Melanotaenia eachamensis

Oxleyan pygmy perch
Nannoperca oxleyana

POTENTIALLY THREATENED

swamp galaxias
Galaxias parvus

non-parasitic lamprey
Mordacia praecox

Yarra pygmy perch
Edelia obscura

Australian grayling
Prototroctes maraena

VULNERABLE

Elizabeth Springs goby
Chlamydogobius n.sp.

saddled galaxias
Galaxias tanycephalus

Flinders Ranges gudgeon
Mogurnda n.sp.

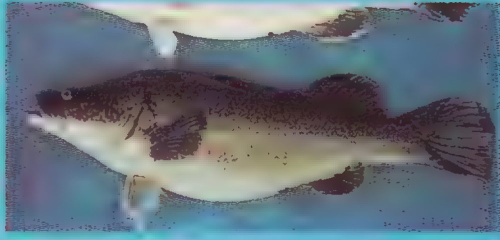
variegated pygmy perch
Nannoperca variegata

honey blue-eye
Pseudomugil mellis

INDETERMINATE

Mary River cod
Maccullochella n.sp.

blind cave eel
Ophisternon candidum



REATENED FISH

swamp galaxias

saddled galaxias

variegated pigmy perch

yarra pigmy perch

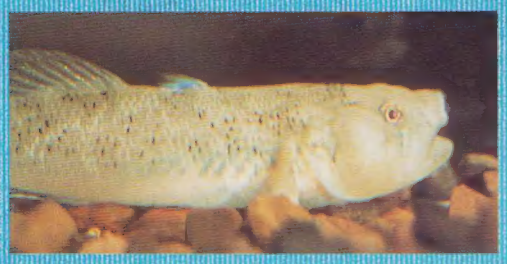
Oxleyan pigmy perch

Flinders Ranges gudgeon

Mary River cod

Australian grayling

honey blue-eye



Elizabeth Springs goby

STARPEACE

THE INFORMATION REVOLUTION

O.K. Mankind! settle down....
RIGHT:
Final Scientific breakthrough— STAR PEACE!
WORLD POLICE
UN

THANKS TO THE BIO-LASER EFFICIENCY SCANNER SYSTEM (BLESS) WE CAN NOW ACHIEVE ENLIGHTENED GLOBAL ORDER (EGO) WITHOUT MOVING A MISSILE!

There is, naturally, an Info-Access Fee (IAF) deducted from the Mankind wage, and a Self Activating Sanction Enforcibility Agency programmed in. OK?
well... what.. er this.. er do we have a choice..

RIGHT.. FEED in everything on the Planet that makes a Profit, and ask it's how to make everyone do it.

WHAT ABOUT FEEDING IN THE QUALITY OF LIFE?

sorry The BLESS IIC doesn't do 'QUALITY' IT WOULD STUFF THE MAINFRAME COMPLET'.. IT DOES FACTS!

OK! A small tap for man, a GIANT TAP FOR MANKIND!
TAP!

What does it say?
BF BUPEET PIP PIP PEEP BIP BIP.

It says.- STARPEACE II
- CANCEL ALL RESOURCE & PROPERTY RIGHTS!
- REALLOCATE ACCORDING NEEDS!
- PRESS 'Y' IF YOU WISH TO PROCEED.
BEEP

UN
PRESS Y
PRESS Y
PRESS IT.. Y.

PRESS Y!
PRESS THE P.RE

SO WHERE'S THE QUALITY OF LIFE?
FEED IT IN ALBERT!
FEED IT IN!
Don't say I didn't...

BOOM
BIP BEEP BEEP BEEP

DISK ERROR ??* CHECKLIST PRODOS??? CONTACT MANUFACTURERS ?????

While STARPEACE is being modified..
WORLD POLICE

..Global order will performed manually.
Petty

PLASTICS RECYCLING REGISTER

Susan Ryan, in Melbourne's Royal Botanic Gardens, on a park bench made from recycled plastic

PLASTICS recycling is a relatively new industry and one that will grow significantly over the next decade. One of the keys to its success is developing viable, long-term markets for the recycled resins. The Plastics Recycling Register, the first of its kind, will help promote the products already using reprocessed plastics and highlight the huge potential.

The register is an initiative of the Environment Action Group of the Plastics Industry Association (PIA). PIA is committed to increased plastics recycling for several reasons. The industry recognises it has a responsibility to work with governments and the community to reduce the problems of waste and litter. Plastics are essential to our economy and lifestyle, but they must be manufactured and used in an environmentally responsible manner.

The recycling industry is small but rapidly growing, characterised by innovative and entrepreneurial companies. Significant technological advances are being made in Australia by the market leaders. Many more opportunities exist for companies with vision and with the technical and marketing skills to fulfil their aspirations.

Plastics recycling is an industry with a future. PIA hopes The Plastics Recycling Register will become a valuable resource for governments and the general community, and will help to promote plastics recycling.

Susan Ryan
PIA Executive Director

Buckets for chores in the home

Florists' bowl

Dog waste disposer

Stylish shopping bags

The Plastics Recycling Register is available from:

PIA
41-43 Exhibition St,
Melbourne, Victoria, 3000
Phone: (03) 654 2199

Looking Ahead

THE PLASTICS INDUSTRY ASSOCIATION INCORPORATED

PIA

THE WORLD'S FIRST VINYL BOOMERANGS

Who knows what these Go Natural bottles were in a previous life? They might have been bottles for cordial or fruit juice. For they are made from recycled vinyl, or Revinyl as we've called it.

They are the world's very first such containers, invented and made by ICI here in Australia. And for the first company to use them, what could be more natural than Go Natural (who make a range of natural household cleaners and skin and hair care products). It makes the complete environmentally friendly package.

SMILE IT'S RECYCLED ICI VINYL

The environment should also be pretty happy about the main ingredient of Revinyl. It's salt, which of course is a renewable resource.

Look out for Go Natural at all good supermarkets. And for more information about Revinyl, please call Andrea Ramm at ICI on (03) 665 7924.

ICI **Plastics**